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*Tools and Technology*

# Evaluation of a Net Launcher for Capturing Urban Gulls

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ABSTRACT The capture of birds is a common part of many avian studies but often requires large investments of time and resources. We developed a novel technique for capturing gulls during the non-breeding season using a net launcher that was effective and efficient. The technique can be used in a variety of habitats and situations, including urban areas. Using this technique, we captured 1,326 gulls in 125 capture events from 2008 to 2012 in Massachusetts, USA. On average, 10 ring-billed gulls (*Larus delawarensis*; range = 1–37) were captured per trapping event. Capture rate (the number of birds captured per trapping event) was influenced by the type of bait used and also the time of the year (greatest in autumn, lowest in winter). Our capture technique could be adapted to catch a variety of urban or suburban birds and mammals that are attracted to bait. 

KEY WORDS capture, gulls, net launcher, urban birds, winter.

In many avian studies, accomplishing specific objectives, such as collecting blood samples, taking biological measurements, attaching transmitters, or banding, require the capture and handling of individual birds. A variety of techniques have been used to capture various species of gulls, including the Wilhelmshaven gull trap, canon nets, pull nets, or hand capture (Horton et al. 1983, Bub 1991, Belant et al. 1998). In addition, walk-in or nest traps, drop traps, funnel traps, or hand capture of flightless young are often used to capture gulls during the breeding season (Mills and Ryder 1979, Smith et al. 1992, Seamans et al. 2010, Alroy and Ellis 2011). Although these techniques have proven effective in certain situations, they are limited in their versatility or efficiency. Various components of pull nets typically need to be anchored to the ground, preventing their use on concrete, blacktop, or frozen soil (Hicklin et al. 1989, Ferris and Bonner 2005). Canon or rocket-nets can be dangerous, need large spaces to be deployed safely, and often require extensive training before use (Bub 1991). In addition, government permits may be required to buy the charges or discharge the net (Prisock et al. 2012, J. Cardoza, Massachusetts Division of Fisheries and Wildlife, personal communication). Walk-in, nest, or funnel traps are limited to situations where the breeding behavior of gulls confines them to specific locations, and gulls must be captured individually.

Capturing gulls during the non-breeding season can add additional challenges because gulls are not constrained to nesting colonies where trapping efforts can be focused. Wintering gulls can be found in a variety of habitats, are often wary of traps, and can roost in different locations on successive nights (D. E. Clark, personal observations). Furthermore, capture methods during the non-breeding season must be effective in a variety of extreme weather conditions, including cold and wind, and also allow for the quick and efficient removal of captured birds.

During the past few decades, more wildlife research has been conducted in urban and suburban environments, and gulls are common and ecologically important members of many of these ecosystems. Wildlife captures in urban or developed areas can be particularly challenging because public relations and public safety are often critical considerations. Wildlife capture techniques in urbanized areas must account for the welfare of both the public and the wildlife resource while still attempting to maximize efficiency and effectiveness (Ireland et al. 1991).

As part of a larger ecological study of urban gulls during the non-breeding season (Clark 2014), we needed to efficiently capture individual gulls for marking. Initial surveys suggested that gulls were concentrated in areas where people were also common (parking lots, public parks, beaches, etc.), and

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therefore required a capture technique that could be used safely in a variety of situations. We found no previous studies that detailed how to capture urban gulls during the non-breeding season. During our early attempts to capture gulls we used walk-in traps and a Steele's pull net with minimal success (Ferris and Bonner 2005). We also used a rocket-net on 2 occasions with some success but the logistics, supplies, and operation proved limiting. Because of these challenges, we developed and evaluated use of a net launcher as a capture technique for urban gulls.

Although other studies have referenced using a net launcher to capture birds, none of these studies provided specific information (Craighead and Bedrosian 2008, Prosser et al. 2009, Herring et al. 2010). We provide a detailed description of how to set up and use a net launcher in urban environments to capture gulls. To evaluate our method under different environmental conditions, we assessed the influence of bait type, temperature, and season on capture success. In addition, we recorded the number of gulls killed or injured during each trapping event to assess the safety of our method.

# STUDY AREA

The ecological study of ring-billed (*Larus delawarensis*), herring (*L. argentatus*), and great black-backed (*L. marinus*) gulls took place in Massachusetts, USA, from 2008 to 2012. Forty-two trapping locations were used to capture gulls and were centered in urban or suburban areas around the cities of Worcester (42º15N, 71´48W), Boston (42º21´N, 71º3´W), and Springfield (42º6´N, 72º35´W), Massachusetts (Fig. 1).

# METHODS

## Trapping Procedure

*Launcher set-up.* – We used a Coda net launcher (Coda Enterprises, Mesa, AZ) to capture gulls (Fig. 2A). The net launcher was similar to a canon net but was smaller in scale and powered by a blank 0.308-caliber cartridge instead of powder charges. The net launcher was classified as a tool and not a firearm by the U.S. Federal Bureau of Alcohol, Tobacco, Firearms and Explosives and therefore did not require special permits to possess or use. The launcher (model 86–6,000) was 86 cm long, 45.5 cm wide, and 40 cm high, and it weighed about 22 kg (Fig. 2A). A fiberglass basket was attached to the front of the launcher where a 6.7-m$^2$ net was placed. On the leading edge of the net, two 13-cm weights (300 g each) were attached to each corner of the net with 160-cm ropes. Two additional 13-cm weights were attached along the net's leading edge with 80-cm ropes so all 4 weights were evenly spaced. These weights were inserted into the 4 barrels of the launcher. On the opposite corners of the net, 2 drag weights (907 g each) were attached with 292-cm ropes. We attached a third 2.7-kg drag weight to the center of the net with a 226-cm rope. The launcher was triggered by an electronic detonator attached to the launcher with a 61-m wire; however, it could also be fired from >60 m using a radio-controlled remote trigger. A variety of net

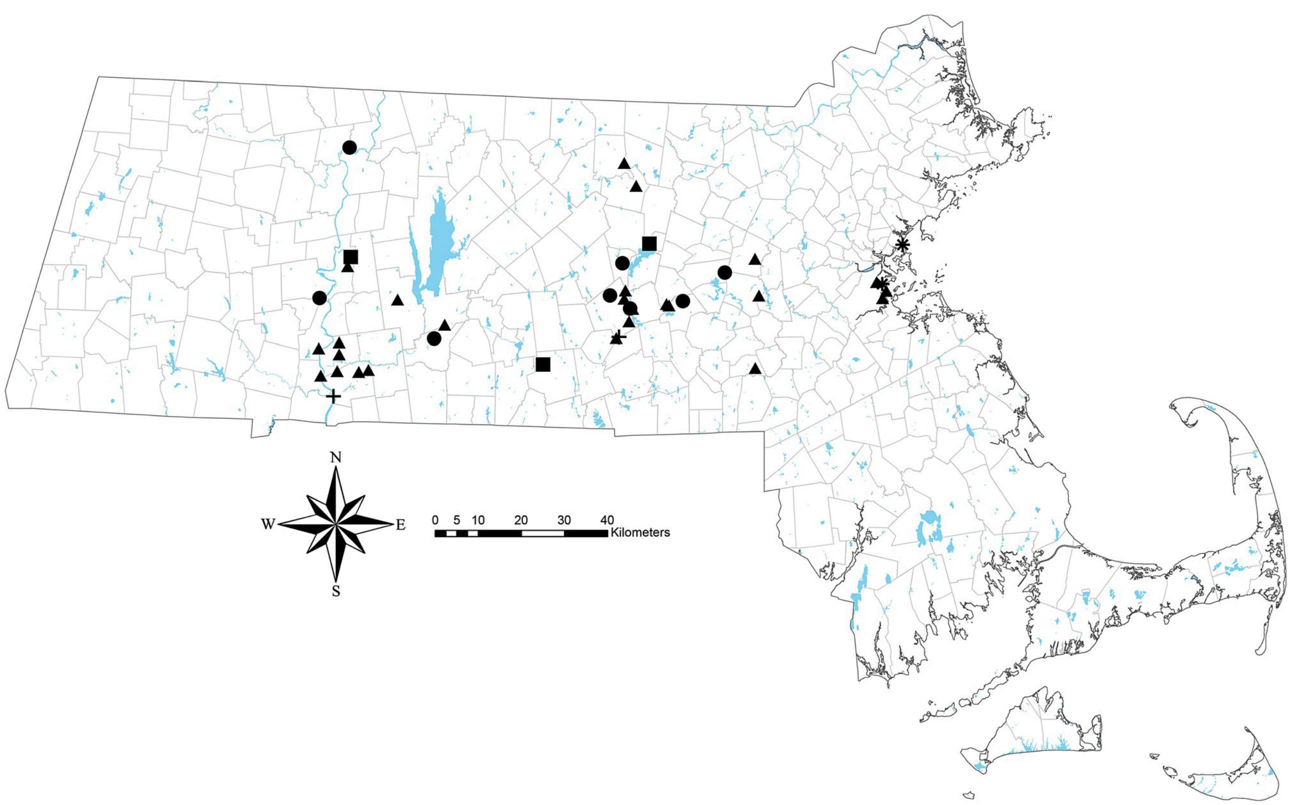


Figure 1. Locations (&, field; ● fresh water; ~, parking lot; *, salt water; +, water treatment plant used to capture gulls in Massachusetts, USA, 2008–2012.


Figure 2. (A) The Coda net launcher used to capture gulls in Massachusetts, USA, 2008–2012. (B) A typical capture set-up in an urban parking lot. The net launcher was placed under the side of the truck and a pile of bait was placed in front. The launcher was detonated from inside the truck cab.

mesh sizes can be used, but we used a 7.6-cm mesh. The launcher cost US$4,290 in 2008.

For all capture attempts, we used 1 of 2 set-ups. The majority of captures were accomplished by placing the net launcher under the side of a pick-up truck (Fig. 2B). Upon arrival at the trapping site, we placed the net launcher on the ground (typically the pavement of a parking lot) just past the driver or passenger's side door of the truck and pushed it partially under the truck so the ends of the 4 barrels were almost flush with the door but still allowed clearance for firing. When possible, we positioned the launcher so the sun and any wind were behind the launcher. This provided some solar concealment and helped reduce the chances that cross-winds would blow the net sideways. We anchored the 2 corner drag weights to the front and rear tire wells of the truck. The center drag weight was placed on the ground under the lip of the launcher's basket. We attached the trigger wire to the launcher and extended it to reach into the cab of the truck. A cartridge (blue tip) was loaded in the chamber, and a pile of bait was placed 3–4.5 m in front of the launcher. We detonated the launcher from inside the truck's cab. Total set-up time was <5 min.

In situations where a truck could not be used (i.e., reservoir shoreline) or when gulls were wary of the truck, we used an alternative set-up independent of the truck that could be adapted to a variety of situations. In this set-up, the launcher was placed directly on the ground and partially concealed or camouflaged. In natural settings, we placed the launcher near vegetation, under a bush, or amid some other natural camouflage (Fig. 3A). In urban settings, we placed the launcher next to existing structures (e.g., light poles), at the base of large snow piles, or next to items commonly found in urban areas (e.g., shopping carts, trash cans, dumpsters; Fig. 3B, C). The launcher was not completely concealed and could be seen. We secured the 2 corner anchor ropes to sandbags or attached them directly to available items. We attached the trigger wire to the launcher and then unwound it 15–30 m away from the launcher. The launcher was detonated by a single researcher standing approximately 30 m away. As in the other set-up, we placed a large pile of bait 3–4.5 m in front of the launcher. Total set-up time was <5 min.


Figure 3. (A) Capture set-up (used to capture gulls in Massachusetts, USA, 2008–2012) along a reservoir shoreline. The Coda net launcher was placed near a bush and partially concealed. (B) Capture set-up at a wastewater treatment plant. The launcher was placed under a guardrail. (C) Photo of net launcher being launched.

We secured captured birds in the net to prevent escape and placed socks over their heads to keep them calm and prevent biting. We removed birds from the net and placed them in poultry cages to wait processing. In most cases, a single bird could be removed from the net in less than a minute.

*Bait*. — Anecdotal observations of gulls being fed in urban areas influenced our bait selection. We observed a variety of food being offered to gulls, which we then used as bait, including bread, crackers, chips (i.e., potato chips, corn chips, etc.), and French fries. Specific bait selection was determined by availability (i.e., close to a bakery outlet) or price. Bread was often the primary bait, and other food items were added to increase the attractiveness of a bait pile (i.e., adding orange cheese crackers for visual appeal). We typically spread the bait pile out in a 1-m oval to maximize the number of gulls that could access the bait. French fries were relatively expensive and used rarely. However, we occasionally added a small number of fries to an existing pile of bait when gulls were reluctant to feed.

### Analyses

To assess the efficiency of our capture method in various situations, we recorded capture rate, or the number of birds captured per trapping event. A trapping event was defined as discharging the net launcher when at least one gull was feeding from the pile of bait. In addition, we recorded several categorical variables that may have influenced capture rate, including location, season, and bait type. Location categories included parking lot, wastewater treatment plant, saltwater beach, field, and freshwater shoreline; seasons were early autumn (Sep–Oct), autumn (Nov–Dec), winter (Jan–Feb), and early spring (Mar–Apr); and bait type, which included bread, crackers, bread and crackers, bread and other (chips, popcorn, etc.), crackers and other, or French fries. Finally, we recorded temperature during the capture event as a continuous variable measured in degrees Celsius.

We tested the effect of trapping location, season, bait, and temperature on the capture rate using Generalized Linear Models with the AICcmodavg package in R 2.15.1 (Mazerolle 2012, R Development Core Team 2012). We modeled our capture data using the Poisson distribution. To test for over-dispersion of the data, we calculated the variance inflation factor ($\hat{c}$; Burnham and Anderson 2002). There was evidence of over-dispersion ($\hat{c}$ ¼ 3.97, df ¼ 123), so the Akaike Information Criterion quasi-likelihood method, $QAIC_c$, was used (Anderson et al. 1994). The AICcmodavg package created model selection tables using the $QAIC_c$ criterion for supplied models. The package also provided confidence sets for the best model. The importance weight for each of the 4 variables was also calculated to determine their relative importance in predicting capture rate (Burnham and Anderson 2002).

We selected a set of 5 *a priori* models to include in our analysis, including the global model. We expected temperature to be an important variable; lower temperatures would potentially increase the response of gulls to our bait pile because of higher metabolic demands in colder weather. In addition, we felt the interactions between Temperature × Season and Temperature × Bait may also be important because changing temperatures may make bait types more or less attractive.

# RESULTS

From 2008 to 2012, we captured 1,326 gulls in 125 capture events. Of the 1,193 ring-billed gulls captured, 748 were adults, 145 were subadults, and 300 were juveniles. Of the 130 herring gulls captured, 92 were adults, 9 were subadults, and 29 were juveniles. Two of the 3 great black-backed gulls captured were subadults, and the third was a juvenile. On average, 9.5 ring-billed (range ¼ 1–37), 1.0 herring (range ¼ 0–21), and 0.02 great black-backed gulls (range ¼ 0–1) were captured per trapping event. All trapping events resulted in at least one gull capture. Most trapping events occurred during autumn (*n* ¼ 57) and winter (*n* ¼ 29), followed by early autumn (*n* ¼ 20) and early spring (*n* ¼ 19). Most capture events took place in parking lots (*n* ¼ 88), followed by freshwater shorelines (*n* ¼ 18), wastewater treatment plants (*n* ¼ 11), saltwater shorelines (*n* ¼ 5), and fields (*n* ¼ 3).

No gulls were killed directly during any trapping event. However, 4 gulls were hit by a net-launcher weight and had to be euthanized. In all cases, a wing was severely broken. Thirteen gulls received minor injuries but were able to be released. Most injuries were cuts and scrapes on the birds' wings, likely caused by the animal struggling under the net against the pavement.

The model containing Season + Bait Type best explained capture rate (Table 1). The Season + Bait Type model was 54 times more likely to explain capture rate than the second-best model, Season + Bait Type + Location. The variables Season and Bait Type were 100 times more likely to explain capture rate than Temperature. Capture rate (the number of birds captured per trapping event [mean ± SE]) was greatest during the autumn (11.12 ± 0.84, *n* ¼ 57) and lowest during winter (9.9 ± 1.1, *n* ¼ 29; Table 2). Although French fries by themselves yielded the largest capture rate (16.0) that bait type was only used once. For bait type used multiple times, capture rate was greatest when Bread + Other (12.5 ± 1.4, *n* ¼ 22) was used during winter or Bread + Crackers (11.9 ± 1.0, *n* ¼ 51) were used during spring.

# DISCUSSION

Urban populations of some gull species have increased dramatically in the past 20 years and some continue to rise (Auman et al. 2008, Duhem et al. 2008, Weiser and Powell 2010). Increasing gull populations are usually associated with anthropogenic food sources, because gulls in urban environments have adapted to exploit food sources such as landfills, garbage cans or dumpsters, or directly provisioned food at restaurants or parking lots (Belant 1997, Belant et al. 1998, Auman et al. 2008, Clark 2014). As gull populations have increased, there is growing concern about the ecological or public health consequences of gulls in urban areas, including impacts on water quality in drinking and recreational water bodies (Fogarty et al. 2003, Nugent and Dillingham 2009). Concerns over urban gulls and water quality have the potential to prompt additional research

Table 1. Results of generalized linear models testing the effects of season, bait type, location, and temperature (°C) on capture rate (number of birds captured per trapping event) of gulls that were captured using a Coda net launcher in Massachusetts, USA, 2008–2012.

| Model[a] | Log-likelihood | $K$[b] | $QAIC_c$[c] | $\Delta QAIC_c$ | Weight ($w$) | % Dev[d] |
|---|---|---|---|---|---|---|
| Season + Bait Type | −473.98 | 10 | 260.71 | 0.00 | 0.98 | 2.77 |
| Season + Bait Type + Location | −470.16 | 14 | 268.67 | 7.96 | 0.02 | 4.43 |
| Season + Bait Type + Location + Temp | −469.89 | 15 | 271.12 | 10.41 | 0.01 | 4.55 |
| Season x Temp + Bait Type + Location | −460.71 | 18 | 274.55 | 13.84 | 0.00 | 8.55 |
| Bait Type x Temp + Season + Location | −458.13 | 19 | 276.03 | 15.32 | 0.00 | 9.67 |

[a] Model parameters include: Season: early autumn (Sep–Oct), autumn (Nov–Dec), winter (Jan–Feb), early spring (Mar–Apr); Bait Type: bread, bread +other, crackers, crackers + other, French fries; and Location: parking lots, fresh water, fields, wastewater plants, and salt water.

[b] Parameter includes intercept and $\hat{c}$.

[c] Values based on the inflation factor of the global model ($\hat{c}$=3.97).

[d] Percentage of deviance explained by the model: (null deviance − residual deviance)/null deviance x 100.

focused on understanding the interactions between urban gulls and humans, along with a concurrent demand for a flexible, efficient, and cost-effective method for capturing gulls.

The net-launcher capture technique we developed was successful and highly efficient at capturing gulls in a variety of urban and suburban locations during the non-breeding season. Most of our captures were ring-billed gulls, likely because they were the most common species present. When herring gulls were present, we were able to effectively capture them as well. Although we did not specifically count or estimate the number of birds available for capture during each trapping event, our method seemed to capture a similar proportion of the available birds. The largest number of birds we were able to bring to a bait pile was approximately 100 gulls, although a more typical response was :::40 gulls and in many cases :::20 birds were present. In general, when large numbers of gulls were attracted to the bait pile, our capture rate increased, and when fewer gulls were present, our capture rate was lower. Our largest capture (37 gulls) occurred when approximately 100 gulls fed from the bait pile, and smaller captures (≤10 birds) often occurred when fewer gulls were available for capture. In general, our technique seemed to capture <50% of the available gulls. Using a larger net may increase the capture rate; however, larger nets are heavier and would likely be slower to deploy and drop over the gulls, thereby increasing the opportunity for them to escape. Gulls seemed to react quickly to the launching net and would often escape out the front or sides of the net.

There was strong evidence ($w_i$ ¼ 0.98) for the best-fit model and the relative importance of Bait and Season; however, the selected models explained very little of the variability in capture rate (Table 1, % Dev.). Other factors we did not consider most likely influenced capture rate. We did not record wind speed during trapping events but observed that gulls were much more wary and unsettled on days when there was a strong breeze and were less likely to settle on the bait pile in large numbers. Gull behavior was likely also important in influencing capture rates. Gulls that reacted quickly and aggressively to a bait pile triggered a behavioral response from other gulls, typically resulting in more gulls feeding from the bait and being focused on feeding. In contrast, there were instances in which gulls exhibited a weak response to bait, and in these cases, we speculate gulls were fed by the public at the capture site prior to our arrival. In general, early morning capture attempts during peak daily hunger times seemed to elicit a greater capture rate (Lees 1948).

The net launcher was relatively expensive compared with other traps or techniques; however, in our case, the initial investment was justified, given the effectiveness of the method. The cost for a single funnel trap or noose mat was approximately US$66.00 and US$155.00, respectively (Hall and Cavitt 2012), but these costs are for a single trap, and most studies would require multiple traps. In addition to requiring multiple traps, many capture techniques require longer set-up times or trapping periods to catch adequate numbers. Heath and Frederick (2003), who used rocket and mist nets to trap white ibises (*Eudocimus albus*), reported

Table 2. Average (±SE, $n$) number of gulls captured per trapping event with a Coda net launcher, by season and bait type, in Massachusetts, USA, 2008–2012.

| | Season ($N$)[a] | | | | |
|---|---|---|---|---|---|
| Bait type | Early autumn (20) | Autumn (57) | Winter (29) | Early spring (19) | Total |
| Bread, cracker | 8.4 (2.5, 5) | 11.3 (1.2, 24) | 10.3 (2.0, 13) | 11.9 (3.6, 9) | 10.9 (1.0, 51) |
| Bread, other[b] | 10.7 (3.4, 3) | 10.8 (1.7, 17) | 12.5 (2.5, 2) | | 10.9 (1.4, 22) |
| Cracker | 10.9 (1.4, 10) | 11.7 (2.3, 7) | 9.8 (2.2, 8) | 11.6 (1.4, 5) | 10.9 (0.9, 30) |
| Cracker, other | 9.0 (–, 1) | 11.5 (0.5, 2) | 8.5 (1.0, 4) | 7.7 (3.2, 3) | 8.9 (1.0, 10) |
| Bread | | 10.6 (3.2, 7) | 8.0 (3.0, 2) | 4.5 (2.5, 2) | 9.0 (2.2, 11) |
| French fries | 16.0 (–, 1) | | | | 16.0 (–, 1) |
| Total | 10.4 (1.1) | 11.1 (0.84) | 9.9 (1.1) | 10.4 (1.8) | |

[a] Early autumn: September–October, autumn: November–December, winter: January–February, and early spring: March–April.

[b] Other could include popcorn, suet, French fries, potato chips, or dog food.

set-up times of 35 and 26 min, respectively, and capture of <2 ibises/day. In contrast, the net launcher in our study was extremely efficient at catching gulls. Almost all our trapping events were set up in <5 min, and in many cases, we captured birds within minutes of setting up. In addition, the net launcher was portable, could be carried and set up by a single researcher, and could be detonated remotely.

One other study described using the Coda net launcher to capture birds but with different results. Prisock et al. (2012) reported catching 137 birds in 23 capture attempts, but none of the target species were gulls. In their study, they used 3 different net sizes, all of which were larger than our net. When using a net size comparable to ours (6 m × 9 m), Prisock et al. (2012) reported capturing one Canada goose (*Branta canadensis*) in 5 capture attempts, while 36 geese, a white ibis, and a great blue heron (*Ardea herodias*) escaped. In addition, they reported pre-baiting trapping stations for >2 days to acclimate the birds to the net launcher. It is likely that subtle differences in capture technique or target species contributed to variability in capture rates. It was unclear how Prisock et al. (2012) anchored their net, but we found that securing the 2 anchor weights to unmovable objects and attaching a third center drag weight caused the net to drop quickly over the baited birds, increasing both the likelihood of catching birds and also the number caught. We never pre-baited our capture sites but instead were able to take advantage of the natural tendency for gulls to respond quickly to bait. Our technique could likely be applied to other birds or even mammals that are attracted to bait. We incidentally captured American crows (*Corvus brachyrhynchos*), mallards (*Anas platyrhynchos*), and rock doves (*Columba livia*) and had the opportunity to capture Canada geese. The net launcher can be safely used in highly urbanized areas with people present. We found most people were not disturbed when the launcher was fired, and very few people reacted to our presence. Based on these findings, the net launcher is an important tool that can be used to capture a variety of avian species, allowing researchers to maximize their time and resources.

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