Workshops increase invasive species reports to EDDMapS in the Mid-Atlantic United States

Rebekah D. Wallace[1*], Charles T. Bargeron[1], Jil Swearingen[2], Joseph H. LaForest[1], David J. Moorhead[1], and Xuelin Luo[3]

[1]Center for Invasive Species and Ecosystem Health, University of Georgia, Tifton, GA USA

[2]Invasive Species Consultant

[3]Experimental Statistics, University of Georgia, Tifton, GA US

*Corresponding author

E-mail: bekahwal@uga.edu (RDW)

Abstract

As the prevalence of smartphones and smartphone applications has penetrated the cellular phone market, and the capabilities of features within smartphones allowed for the replacement of commonly used mapping and identification tools, Bugwood developers began to release smartphone applications for reporting invasive species. To encourage and demonstrate reporting, workshops have been held to walk users through the apps features and overall EDDMapS capabilities. To ascertain the effectiveness of workshops in encouraging reporting via smartphone apps and the EDDMapS MAEDN website, a General Linear Model was used to evaluate the number of reports received across the 2012-2017 time frame and evaluate if there was a difference in the number of reports in the years workshops were held at the Mid-Atlantic Invasive Plant Council conferences and years no workshop was held. The model indicated that workshop and time were significant factors in the number of reports submitted. Being able to confidently demonstrate the effect that workshops can positively impact data recruitment can aid in funding for outreach and educational events.

Introduction

The Early Detection and Distribution Mapping System (EDDMapS) is a database-driven website for invasive species occurrence reporting, data aggregation, data visualization, and source to download publicly available records and maps was released in 2005 and was primarily focused on invasive plant mapping in the Southeast U.S. EDDMapS has now expanded to include mapping invasive insects, wildlife, and diseases across North America [1]. EDDMapS was

46 developed with two primary purposes, to aggregate data from existing sources and for web-based
47 reporting of new occurrences. The web reporting form's fields and data formats were designed to
48 conform to the North American Invasive Plant Mapping Standards [2], so that professionals and
49 citizen scientists alike could directly contribute to the database. While the majority of data
50 entered each year comes from large datasets submitted by federal and state agencies and
51 universities, reports from individuals and regional projects entered through the EDDMapS-
52 powered websites and smartphone apps are very important for identifying new and expanding
53 invasive species populations. Bugwood works with regional projects throughout the U.S. and
54 continues to leverage new technology for invasive species mapping and education.

55 As technology advances, new developments are often evaluated for applications in all types of
56 fields. Most recently, the cell phone has evolved into the smartphone and has become an
57 important tool that is useful for more than just calling or texting. Inherent features on
58 smartphones such as the camera, GPS location, internet connection, and downloadable apps,
59 have turned the phone into a increasingly useful tool for personal and professional life. This
60 utility has led to their overwhelming adoption among adults in the U.S. As of 2014, 64% of U.S.
61 adults owned a smartphone and 46% said that their smartphone is something that they "couldn't
62 live without." Owners feel that the phone gives them a sense of freedom (70%) rather than
63 viewing it as a leash (30%) [3]. In fact, smartphone ownership in the 18-29 age group is at 85%
64 and decreases with increasing age; 30-49 at 79%, 50-64 at 54% and 65+ at 27%[3]. Fully 78-
65 80% of smartphone owners, ages 18-50+, report that their smartphones make them feel that they
66 are productive [3]. While the native features have provided general increases in productivity, the
67 downloadable apps have added specific value to the owners' experience with the number and
68 diversity of apps targeted as specific tasks increasing each year.

Before smartphone mapping technology was available for invasive plants, surveyors needed to pack a GPS unit, camera, identification guides, notebook/surveying sheets, pens, and potentially even more equipment for any specialized testing or sampling. An accuracy comparison of smartphones representative of the two operating systems and a commonly used GPS unit show that while the smartphones had a higher median location error, the Droid X with 5.2 m and the iPhone 4 with 4.6 m, they were not far from the and Garmin eTrex Legend H (2.4 m) [4]. In evaluating the quality of the smartphone camera, Hagman and Riedberg [5] compared an Apple iPhone 5 and a Samsung Galaxy S5 with a Nikon D700 in a typical medical photography situation and found the smartphones to perform well against the expensive, single function DSLR camera. As the features on the smartphones have become better, more precise, and comparable to the single-function units, surveyors have become more comfortable using these convenient tools.

The Mid-Atlantic Invasive Plant Council (MAIPC) conferences tend to draw people who are managers of lands of various size and ownership, program coordinators, volunteer managers, and others involved in the invasive species communities as professionals or individuals. The aim of the EDDMapS training sessions at the MAIPC conference have been to show how to use the websites and the smartphone apps for reporting, as well as how to navigate around the websites for data querying, accessing maps, aiding in identification, and other tools and features. For those in charge of large areas or managing a crew, they can use the tools from EDDMapS to aid in their invasive species monitoring and control efforts. The attendees of these workshops are learning to become proficient users of EDDMapS and can take what they learn back to their program and train their crew or volunteers, in a “train-the-trainer” or “pyramidal” style training scheme [6]. These methods have already proven effective in other programs, such as training

people who oversee others in a healthcare setting to learn how to interact with people with behavioral issues and in establishing proper procedures (such as cardiopulmonary resuscitation and other techniques) [7-8]. This model is also more cost and time efficient for the primary trainer (in these workshops, EDDMapS' staff) to train the land managers, and the land managers to train their crew members, than for individual trainings to take place at multiple locations, and it has been proven in other studies that there is relatively high information retention rate for this training method [9-10].

With some regions, advertisement to the public was a priority to encourage invasive species reporting. The first EDDMapS developed reporting application was IveGot1, created in conjunction with Everglades Cooperative Invasive Species Management Area (Everglades CISMA) with funding by National Park Service – Everglades National Park [11]. The purpose of the app was for public awareness as much as it was for encouraging reporting of invasive species, primarily pythons and other reptiles [11]. The IveGot1 campaign has been deemed a success, as determined by increasing numbers of reports from the public, due to support by local CISMAs and other programs across the state, extension publications, and marketing via billboards, print advertisements, bumper stickers and more [11]. A similar tactic was used by the Missouri River Watershed Coalition/EDDMapS West region for increasing awareness and encouraging reporting of invasive species. That region's funding came from a variety of sources and was used in part to create advertisements and educational materials, such as print news articles, interviews, guides, and videos on invasive species [12-14].

Methods

Whereas the EDDMapS West/MRWC apps likely benefitted from all of the advertisement about invasive species, we can directly see the impact of outreach by looking at reporting in the EDDMapS Mid-Atlantic Early Detection Network (MAEDN) region. The MAEDN website and smartphone applications (iOS and Android platforms) were launched in 2012 and encompasses Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia (Fig 1). Groups within the MAEDN region have been concerned with invasive species for many years but tracking of invasive species was variable and the data was not broadly aggregated or with a singular reporting venue promoted to easily allow for tracking. Since the regional website and apps launch, Bugwood Staff and project partners have presented at several of the regional workshops and conducted demonstrations on reporting and walk-throughs of the MAEDN app. MAIPC held conferences in July or September each year from 2012-2017 and a workshop on the MAEDN apps and website was conducted in 2012, 2013, 2014, and 2016. EDDMapS' staff presented in 2012, 2014, and 2016 and a project partner presented in 2013.

Figure 1. Mid-Atlantic Early Detection Network Region

Region of the United States that is within the Mid-Atlantic Early Detection Network is colored blue and includes Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia.

The MAIPC conferences had presentation sessions entirely revolving around identification, reporting, control, mapping, emerging invasive species and more, which EDDMapS' staff was involved in soliciting and curating topics of presentations during several of the years. Presenters were allotted 30-60 minutes to demonstrate the EDDMapS MAEDN website and apps, and cover existing and new features added each year as technology evolved. Presentations were a

combination of a prepared projected slide presentation and live demonstration of the applications and website. Each year also included a separate hands-on field exercise in a nearby area to allow attendees to practice navigating through the apps and reporting invasive species using the app. Presenters would roam the area and offer attendees guidance as needed during the field exercise. After the field exercise, attendees were regrouped with the presenter to discuss their experience, assess mapping results, answer questions, address any issues that arose, and discuss the review process and publishing of reports after the data are sent to the EDDMapS database. These exercises helped attendees see and better understand the various aspects of the MAEDN apps and the EDDMapS website and provided them the knowledge they needed for their invasive species management programs. Attendees also gained the skills needed to teach their crews, staff, and volunteers how to incorporate the tools into their existing programs.

Results

The focus of the workshops was presentation and demonstration of EDDMapS and the MAEDN smartphone app and applicability to existing invasive species programs. The percentage of reports submitted via the MAEDN smartphone app rapidly grew over the 2012-2017 timeframe. By the second year that the apps were available, they were the source of over 63% of individual reports submitted and each year since has been the source of 53-86% of individual reports (Table 1). This trend is also being observed in the EDDMapS database for other regions of the U.S., as both the public and professionals are finding convenience in using smartphones to report invasive species.

Table 1. Number of individual reports submitted via MAEDN website and smartphone apps

Year	Smartphone Reports	Web Reports	Total	Smartphone %	Web %
2012	113	165	278	40.64748201	59.35251799
2013	683	386	1069	63.89148737	36.10851263
2014	645	440	1085	59.44700461	40.55299539
2015	500	431	931	53.7056928	46.2943072
2016	2525	389	2914	86.65065202	13.34934798
2017	1538	421	1959	78.50944359	21.49055641

Number of reports submitted to the EDDMapS database via the MAEDN smartphone applications, the MAEDN website, the total of the apps and website, the percentage of total reports coming from smartphone apps, and the percentage of total coming from the MAEDN website. Submissions via smartphone apps accounted for a higher percentage of the total individual reports contributed compared to web reports by the second year (2013).

To assess the impact of events on individual reports submitted to EDDMapS in the MAEDN region, we evaluated the number of reports received during June, July, August, and September (summer) of 2012-2017. Data was evaluated in SAS with a General Linear Model (GLM) expressed as:

$$Y=\mu+a*E+b*T+e$$

where μ is the intercept, a is decreased counts when there is no event, $E=\begin{cases}1, & no\ event;\\ 0, & event.\end{cases}$, b is the slope of time, and T is time, e is random error. The number of reports received during the summer of each year is the dependent variable (Reports = Y) and the workshops is the independent variable (Event = a). The fitted model is $\hat{Y}$= -50.8229870 - 266.5790140*E + 9.6626487 * Time. It has an R^2 of .758404. The p-value indicated that Time and Event were both significant in number of reports submitted (Table 2).

Table 2. Type III Sum of Squares

Source	Degrees of Freedom	F value	Pr>F
Time	1	65.90	<.0001
Event	1	26.46	<.0001

Type III Sum of Squares shows that Time and Event are both significant factors in the number of reports received from the MAEDN project area with p-value of <.0001.

Figure 2 indicates that reports spike during summers in general, but the model indicates that events result in a significant increase in the number of reports submitted through the MAEDN website and apps. The model also indicated that Time is a significant variable, and as groups and individuals have attended these workshops and discovered the reporting apps and website through other means (e.g. word of mouth, media, conferences, etc.) reporting has increased over the years. This increase in reports over the course of time is reflected in the linear regression line: $y=ax + b$, where y is the number of reports, a is the slope of the line, x is Time, and b is the intercept.

Figure 2. Number of Individual Reports by Month in MAEDN

Caption: Number of reports submitted through the MAEDN website and the MAEDN smartphone apps on a monthly basis are represented by the solid blue line. The EDDMapS workshop events are represented by a vertical orange line marking the month of the event. A linear regression ($y=ax + b$), where y is the number of reports, a is the slope of the line, x is Time, and b is the intercept, over the analysis period was included to show increasing reports over the time frame is represented by the black broken line.

A least square means (LSM) of the fitted model of the GLM was also evaluated to predict if there would have been a significant effect of a workshop on the number of reports submitted in 2015 and 2017, the two years that did not have workshops during the time frame. June was selected as this is the naturally occurring height of reporting during years events were not held. The LSM evaluated the effect of a workshop conducted in June in 2015 and June 2017 and found that both years would have had a significant increase in reports at 95% confidence limits (Table 3). This indicates that it would be beneficial to attempt to regularly host workshops at the MAIPC conference to increase awareness, and thus reporting.

Table 3. Least Square Means at June in 2015 and 2017*

Event	Total Least Square Means	95% Confidence Limits	
June 2015 No Event	88.49.29243	11.734758	165.123728
June 2015 Event	355.008257	295.852897	414.163617
June 2017 No Event	320.332811	246.57.418	394.095204
June 2017 Event	586.911825	482.035885	691.787765

*Numbers used for No Event in this evaluation were calculated from the model. Least Square Means at 95% confidence limits shows that if workshops were held in 2015 and 2017 at the MAIPC conference, there would have been an increase in total reports submitted to EDDMapS.

Conclusions

A GLM analysis of reports from smartphone applications and web reports in the MAEDN area from 2012-2017 were evaluated to determine the effect of workshops conducted at the MAIPC conference on the number of reports submitted to the EDDMapS database. Workshops on

MAEDN, and specifically on the MAEDN smartphone applications, were conducted to an audience mainly comprised of landowners, professionals, and those responsible for crew, staff, or volunteers. Due to staff or partner unavailability, workshops were not held in 2015 and 2017. The GLM indicated that Year and Event were significant in the number of reports submitted through the MAEDN website and MAEDN smartphone apps. This indicates that while reports are increasing each year, potentially as word spreads, organic web searches, or by attending non-MAIPC EDDMapS presentations, the MAIPC workshops are also important in encouraging reports in this region. The LSM indicates with a 95% confidence limit that, were workshops conducted in 2015 and 2017, similar increases in reporting would have been observed. With this information, funding and support may be able to be sought and directed to attending and demonstrating at comparable events in other regions to attempt to replicate this effect.

References

1. Center for Invasive Species and Ecosystem Health [Internet]. EDDMapS History. [Cited 15 December 2018]. Available from: https://www.eddmaps.org/about/history.cfm
2. North American Weed Management Association. North American Invasive Plant Mapping Standards. Fargo (ND) 2002 May. Cited 15 December 2018. http://www.naisma.org/images/Mapping_Standards.pdf
3. Pew Research Center. The smartphone difference. [Internet] 2015 [Cited 2018 Dec 15] about 60 p. Available from: http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/
4. Olson DD, Bissonette JA, Cramer PC, Green AD, Davis ST, Jackson PJ, Coster DC. Monitoring wildlife-vehicle collisions in the Information age: How smartphones can improve data collection. PLoS ONE. 2014. 9(6): e98613. doi:10.1371/journal.pone.0098613.
5. Hagman A, Riedberg S. Guidelines for smartphone usage in telemedical photography [Bachelor Thesis]. Sweden: School of Technology and Health, Royal Institute of Technology; 2014. Cited 15 December 2018. Available from: http://kth.diva-portal.org/smash/get/diva2:743716/FULLTEXT01.pdf
6. Pence ST, St. Peter CC, Tetreault AS. Increasing accurate preference assessment implementation through pyramidal training. Journal of Applied Behavior Analysis. 2012. 45: 345–359. doi:10.1901/jaba.2012.45-345.
7. Rajapakse BN, Neeman T, Dawson AH. The Effectiveness of a 'Train the Trainer' Model of Resuscitation Education for Rural Peripheral Hospital Doctors in Sri Lanka. PLoS ONE. 2013. 8: e79491. doi:10.1371/journal.pone.007949
8. Rosenthal ME, Adachi M, Ribaudo V, Mueck JT, Schneider RF et al. Achieving housestaff competence in emergency airway management using scenario based simulation training: comparison of attending vs housestaff trainers. Chest. 2006. 129: 1453-1458. doi:10.1378/ chest.129.6.1453. PubMed: 16778261

9. Martocchio N, Rosales R. An evaluation of pyramidal training to teach implementation of the picture exchange communication system. Behavioral Interventions. 2016; 31: 265–282
10. Yarber L, Brownson CA, Jacob RR, Jones E, Baumann C, Deshpande AD, Gillespie KN, Scharff DP, Brownson RC. Evaluating a train-the-trainer approach for improving capacity for evidence-based decision making in public health. BMC Health Services Research. 2015. 15:547 DOI 10.1186/s12913-015-1224-2
11. Wallace RD, Bargeron CT, Moorhead DJ, LaForest JH. IveGot1: Reporting and Tracking Invasive Species in Florida. Southeastern Naturalist. 2016. 15(8):51-62
12. Nebraska Game and Parks Commission. Sportsman's Guide to Invasive Species. 2012. Cited 15 December 2018. Available from: http://web.archive.org/web/20150906011905/http://www.outdoornebraska.ne.gov/Fishing/pdfs/invasive_species/SportsmansGuide_2013.pdf
13. Anderson T. Phone app, $1.3M aimed at helping Utah win the weed war. The Salt Lake Tribune. 10 June 2013. Available from http://www.sltrib.com/sltrib/news/56438157-78/state-utah-weeds-weed.html.csp Cited 15 December 2018.
14. Center for Invasive Plant Management Steering Committee. Conference Call Meeting Minutes. (4 September 2012). Available from: http://web.archive.org/web/20150926025804/http://www.weedcenter.org/about/docs/SC%20Minutes/2012Sept.pdf Cited 15 December 2018.

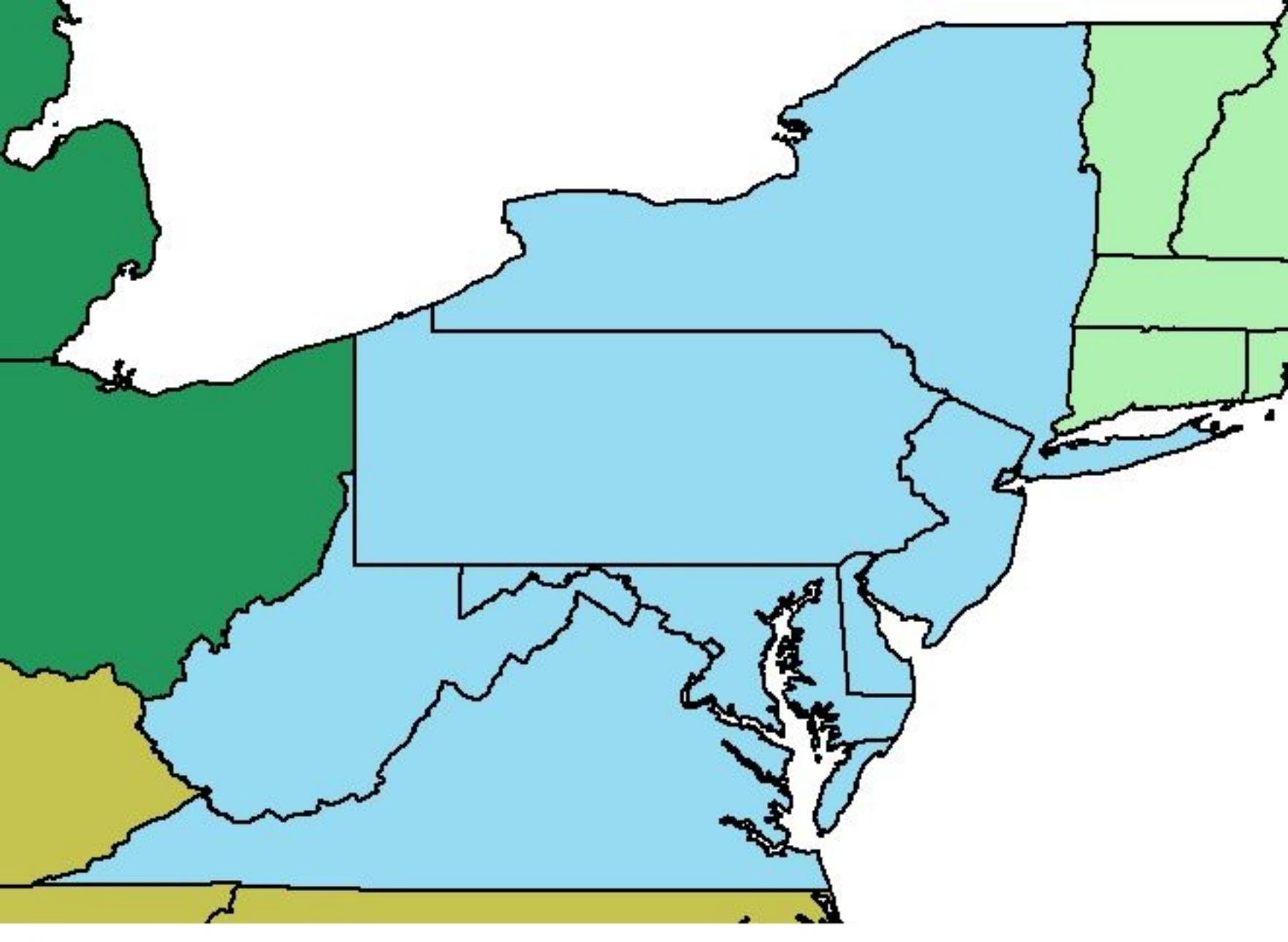

Figure 1

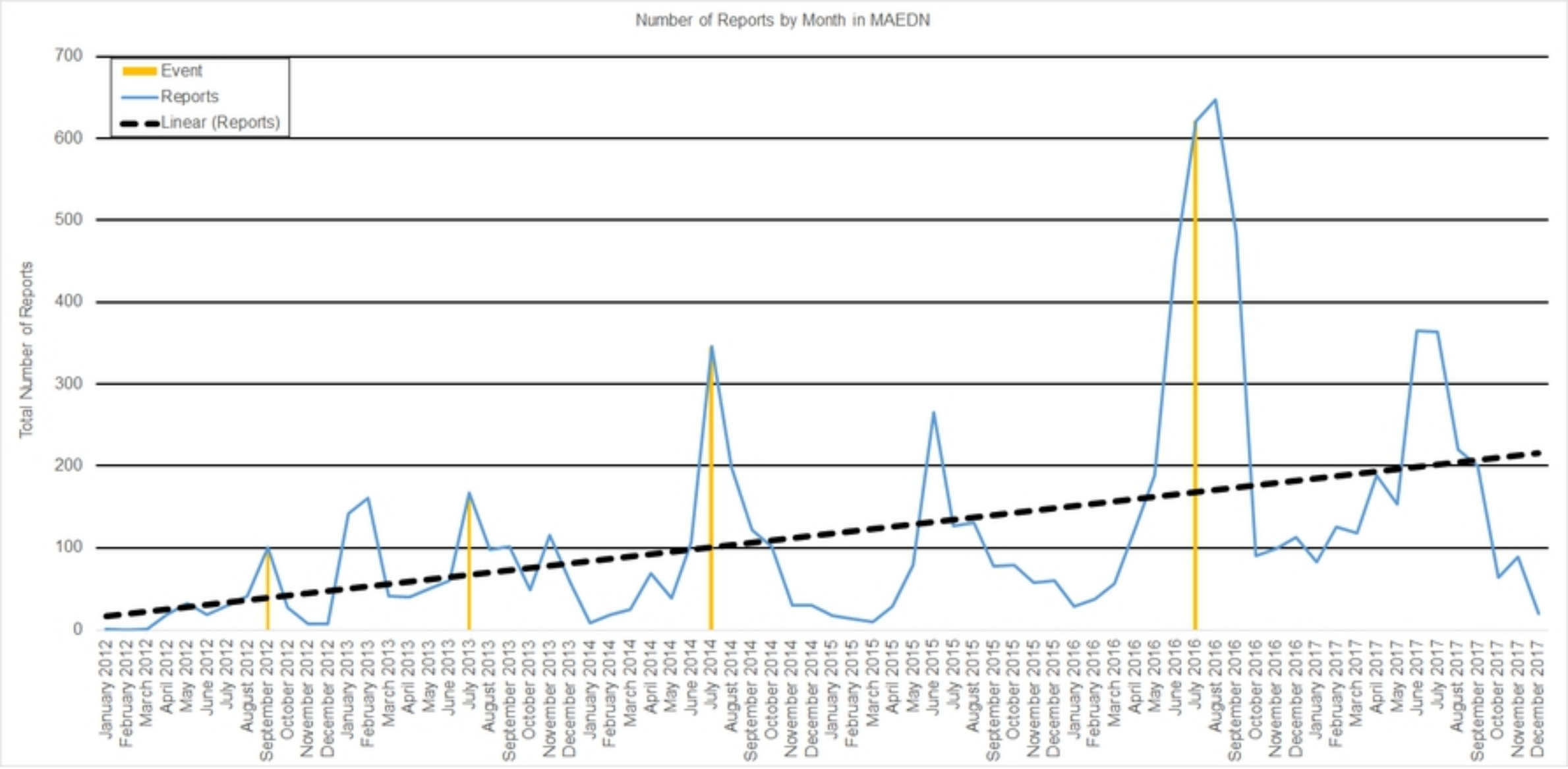
Number of Reports by Month in MAEDN
Event
Reports
Linear (Reports)
Total Number of Reports
700
600
500
400
300
200
100
0
January 2012
February 2012
March 2012
April 2012
May 2012
June 2012
July 2012
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Figure 2