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Research Article

The new toad in town: Distribution of the Asian toad, *Duttaphrynus melanostictus,* in the Toamasina area of eastern Madagascar

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Abstract
In March 2014, the Asian toad *Duttaphrynus melanostictus* was reported from Madagascar's second largest city and main port Toamasina, raising immediate concerns about the invasive nature of the newly introduced toad and its environmental impact should it spread throughout the island. As part of a study on the feasibility of eradication, we conducted 516 interviews and 120 visual encounter surveys between April and November 2014. We found the toad to be widespread to the south and west of city center and estimate its minimum range to include an area of at least 108 km^2. Social surveys indicate that the toad may have already been present for some years and potentially introduced prior to 2010, with the site of its introduction likely south of Toamasina near National Route 2 and the Ambatovy Plant. We discuss limitations of our survey methodology, proposed improvements for future work, and the implications of our results on eradication and control measures.

Key words: invasive species, Madagascar, Asian toad, Toamasina

Résumé
En Mars 2014, la présence du crapaud asiatique *Duttaphrynus melanostictus* a été rapportée dans la deuxième plus grande ville de Madagascar et le principal port : Toamasina. Des inquiétudes ont immédiates ont été soulevées à propos de la nature invasive de ce crapaud nouvellement introduit et de son impact sur l'environnement si il venait à se répandre dans toute l'île. Dans le cadre d'une étude pour déterminer la faisabilité de l'éradication, nous avons mené 516 entrevues et 120 prospections visuelles entre Avril et Novembre 2014. Nous avons trouvé que le crapaud est principalement distribué au Sud et à l'Ouest du centre-ville sur une superficie minimale estimée d'au moins 108 km^2. Les enquêtes sociales indiquent que le crapaud était peut-être déjà présent depuis quelques années et potentiellement introduit avant 2010, avec le site probable d'introduction initiale identifié au Sud de Toamasina près de la route nationale 2 et de l'usine d'Ambatovy. Les Limitations de notre méthodologie d'enquête, les améliorations pour les travaux futurs, et les implications de nos résultats sur les mesures d'éradication et de contrôle sont discutées.

Mots clés: espèce envahissante, Madagascar, crapaud asiatique, Toamasina

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Introduction

Invasive species are among the greatest threats to biodiversity and of utmost concern to conservationists [1-3]. Within the Convention on Biological Diversity, the threat of alien invasive species is one of the 20 Aichi Biodiversity Targets for 2010-2020 [4]. Amphibians consistently rank among the most damaging vertebrate biotic invaders worldwide [5]. Amphibian species with the capacity to become invasive outside their native range are typically highly fecund, are easily transported, and have a generalist diet [6]. One such species is the Asian toad, *Duttaphrynus melanostictus*, a toad native to Asia recently detected in Madagascar, which is a significant pest in other tropical coastal areas [7-8].

In its native range, *D. melanostictus* inhabits a wide range of environments, including forests, agricultural land, and urban areas, where it is found up to 1,800-2,000 meters a.s.l. [9-10]. It reproduces throughout most of the year in tropical areas, with a peak during the monsoon season [11]. Populations in more temperate regions go through a period of inactivity during which reproduction stops when temperatures drop to 17°C [12]. In Cape Town, South Africa, an individual was found alive inside a shipping container transported from China [13], proving the adaptable nature of the species and how easily it can be moved unintentionally with imported goods. *D. melanostictus* also has a varied diet, with one study finding a range of invertebrates from more than 20 families within its stomach contents [14].

In March 2014, the scientific and conservation communities were alerted to the presence of the toad around Madagascar's main port and second largest city, Toamasina, causing widespread concern about the species' invasive nature and impact on native biodiversity. Questions were raised about the toad's origin, timing of the invasion, means of arrival, and the feasibility of control measures or eradication. Concerns especially focused on the potential effect that the toad could have on native fauna, an astounding 84% of which are endemic [15]. Only one other exotic amphibian species has been introduced to the island, the Indian tiger frog *Hoplobatrachus tigerinus*, and it is unclear when this species became established or the consequences of its introduction [16-17]. The newly introduced Asian toad on the other hand, presents a number of serious ecological impacts, including competition for resources, introduction

of foreign pathogens, effects of predation, and the possibility that the toad's natural defensive toxins could harm naïve predators [18-19]. These concerns were heightened after the ecological niche of the species was modeled, revealing that Madagascar's climate, especially along the east coast, is ideal for the toad to spread [20].

Because *D. melanostictus* is poisonous, these concerns also extend to human health risks. *D*. *melanostictus* is implicated as the cause of poisoning in humans through consumption in Laos and has also been documented as the cause of death and cardiac arrest in children who have consumed toad tissue [21]. This health risk is elevated in the case of Madagascar, as its extensive rural populations to some extent rely on hunting and gathering for their sources of protein, their diet can include Anurans, and many people are unaware of the poisonous nature of the Asian toad. In addition to the Keomany [21] study there are a number of other cases of poisoning from consuming toads or their eggs [22-27]. The health impacts of Asian toads in Madagascar may therefore be significant and lethal to humans, especially in communities where people eat frogs as a routine part of their diet.

When an invasive species is detected, determining its distribution is crucial in order to predict the rate at which a species will expand its range and to inform eradication or control strategies. These data, however, are often limited to randomly collected observations not recorded in a systematic manner, which affect the accuracy of such work [28]. Distributional data of invasive species, when possible, should therefore be collected methodically rather than through anecdotal reports. To this end, we describe our systematic surveys for *D.melanostictus* conducted from May to November 2014, as part of work to determine the feasibility of its eradication. We suggest a possible arrival time of the toad based on results from interviews with residents and offer a minimum distribution as of November 2014. We also discuss the limitations of our survey methodology, the importance of improving biosecurity measures in Toamasina, and the implications of the toad's distribution on potential control or eradication measures.

Methods

Two survey methods were used to assess the distribution and arrival time and location of the Asian toad in Madagascar: 1) a social investigation with local residents using *Chef Fokontany* (elected village officials) as the initial point of contact, and 2) visual encounter surveys at night.

Social Surveys

Initial interviews with residents took place on 30 April 2014 and 2 May 2014, with the help of 38 students from the *Institut Supérieur des Sciences Environnemental et Développement Durable* (ISSEDD). Students were divided into 17 groups of two to three people, and each group visited between two and 14 sites. At each site, the group first sought out the local *Chef Fokontany* and then asked permission before interviewing individual residents about1) if they had seen the toads at the site, 2) when they remembered first observing them, and 3) if they considered there to be many or few toads present. Informed consent was obtained from residents during interviews. Identification of *D*. *melanostictus* was not a concern because of recent media attention and the unique appearance of the species, which does not closely resemble any other amphibian in Madagascar (Fig. 1).

A second series of social surveys were conducted from 8-16 October 2014 by eight ISSEDD students divided into four teams. The methodology was the same as the earlier surveys, except that geographic coordinates were recorded using a Garmin GPSMap 60CSx GPS unit, the surveyors omitted question #3, and multiple residents were interviewed per site.

Fig. 1. The Asian toad in Toamasina showing its distinct appearance and size which is unique and unlike any other amphibian species in Madagascar.

Visual Encounter Surveys

We carried out visual encounter surveys both to confirm reports from residents and to attempt to delineate the zone of incursion. Based on reports that the southern part of Toamasina surrounding the Ambatovy Plant already had a well-established population of toads, and considering the Indian Ocean to be the eastern-most limit, we plotted points expanding outwards to find locations on the edge where toads were absent or where densities were not yet high enough for the toad to easily be detected. These survey points were no less than 300 meters from each other and were selected for both their accessibility and their strategic location. Satellite ("BirdsEye") imagery in Garmin BaseCamp was used to plot points, which were then loaded onto a Garmin eTrex20 and Garmin GPSMap 60CSx GPS unit.

Surveys were conducted by a team of four to six people (and on a few nights a group of ten). Between two and six points were surveyed in a single night, depending on their location and accessibility. The survey team began no earlier than 17:30 and continued no later than 21:00. Once a team arrived at the specified point, they walked together 300 paces in each cardinal direction (or as the landscape allowed) until a toad was observed. To save time, surveyors did not actively search for toads by turning over material or disturbing cover, but scanned the ground for active individuals using headlamps and flashlights. If a toad was observed, its presence was noted, and the team stopped searching and moved to a new point.

Results

516 residents were interviewed (141 in April-May, and 375 in October 2014) and 359 reported toads present at the site. The majority of residents interviewed reported first observing toads in 2014, while the earliest reports were from 2010 (Table 1). The five earliest reports were from Tanambao Verery (May and October 2010), Sosomita (2010), Andranokilaho (2011) and Tanandava (2011).

Table 1. Residents who reported first observing toad per year given by number and percent. The last row "N/A" refers to interviews which did not result in an answer with a date as the time period (i.e. "a long time ago").

Year First Observed	Number of Residents	% of Total Residents
2010	3	0.8%
2011	2	0.6%
2012	12	3.3%
2013	74	20.6%
2014	228	63.5%
N/A	40	11.1%

From 120 visual encounter surveys conducted over 37 nights, we found toads at 48 sites (Appendix 1). They were found in all habitat types surveyed, from urban environments around houses and courtyards to more rural villages, agricultural land, and rice paddies, as well as mixed Eucalyptus forests, secondary vegetation, and neighboring grassy areas (Fig. 2). Toads qualitatively appeared to be most abundant around villages, and especially were seen around piles of garbage and debris.

Fig. 2. The range of habitats where the Asian toad occurs around Toamasina. A) A waterway running through the city. B) Garbage pile and housing on outskirts of town. C) Grassy field and debris near center of distribution south along National Route 2. D) Temporary pond and surrounding scrubby vegetation around housing near industrial area south of the city. E) Aerial view showing a portion of the northeastern distribution of the toad. F) Rural land, Eucalyptus forest, and river in the southern portion of the known distribution.

The farthest point south that the toad was detected was Ambokarivo in Mahatsara (S18.28533; E49.32468) and the farthest north at a site approximately 500 meters north-northeast of Barikadimy (S18.13043; E49.37845). The toad was confirmed within less than 1 km of the ocean to the east, while the western-most points were Ambatavia (S18.19786; E49.29832) and Morafeno 2 (S18.15126; E49.30281), both located near the Ambatovy Tailings site. The toad was not detected near the center of the city, towards the airport, or farther north along National Route 5, or on National Route 2 south from Antanambao to Sandrangetana. Tracing the smallest possible convex polygon around the outermost sites of detection provides a minimum area of occupancy of 108 km^2, with the centroid located along Route National 2 at S18.19206 E49.34256, approximately 1 km west of the Ambatovy Plant and the railway that runs south from the port through this area (Fig. 3 and Fig. 4).

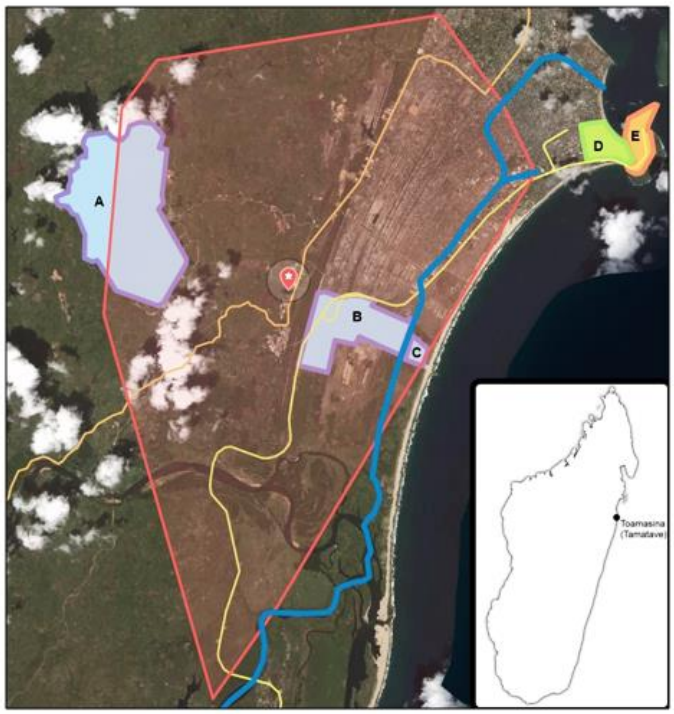

Fig. 3. Map of the distribution of the toad showing key features around Toamasina. A) Ambatovy tailings. B) Ambatovy plant. C) Ambatovy residential camp. D) city center. E) port. The starred flag corresponds to the centroid of the polygon and possible vicinity of introduction. The orange line is National Route 2 and National Route 5 and the yellow line is the railroad. The blue line is the Canal de Pangalanes. Map created using Mapbox (www.mapbox.com

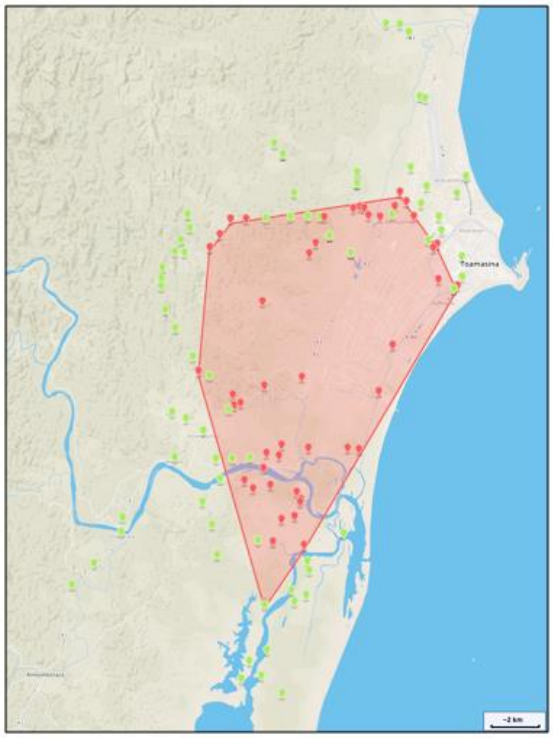

Fig. 4. Map of all 120 visual encounter survey locations and the resulting distribution polygon for the Asian toad. Red flags correspond to sites where the toad was detected and green flags where the toad was not detected. Map created using Mapbox (www.mapbox.com).

Discussion

Survey Considerations

It is important to note that interviews with the local population were done in a limited amount of time and on a voluntary basis, in the earliest case initiated before funding for surveys was secured. Voluntary and citizen-based biological research programs may have a greater possibility for bias and error than those carried out by researchers themselves [29-30]. While we made an effort to validate presence and absence data through visual encounter surveys following the first set of interviews, the estimated time of arrival could only be based on memory of individual residents. The majority of respondents reported first observing toads in 2014 and only a very few recalled seeing toads as early as 2010 or 2011. If the toad was introduced first prior to 2010, it would likely have occurred in low densities and at very few sites, and would therefore have been observed by very few people, if any. Only after 2-3 years of establishment and breeding would the toads become more detectable as their numbers grew and their range expanded.

It is interesting that there have been no reported observations of the toad in the city center or nearby at the port. The absence of toads at the port was substantiated by staff from Ambatovy who surveyed the area [31]. Toamasina is the largest port in Madagascar and therefore seems the likely entry location, but it does not seem to be an area where the toad has established a population despite suitable habitat being available. This suggests that the toads could have arrived at the port inside a shipping container and then been moved elsewhere inside the container to become established farther south, where all reports prior to 2014 are located. Indeed, the centroid of the distribution polygon is in an urban and industrial area south of Toamasina city, and assuming the toad has spread equally in all directions since its introduction, this could indicate where the toad initially established a population. The earliest social survey reports from 2010 and 2011 also are found around this center of distribution.

The sensitivity of our visual encounter survey methodology was likely low, and therefore the distribution that we provide is an absolute minimum and certainly underestimated. Furthermore, by the time this article is published the distribution of the toads will undoubtedly have expanded. Future visual encounter surveys could be improved by revisiting sites where toads were not detected over multiple nights, in varying weather conditions, as well as actively searching for individuals during the day by disturbing refuges and cover. It is important in such surveys to quantify detection probability to determine the accuracy of detection [32]. Future delimitation studies should also account for imperfect detection through methods such as modeled proportional occupancy [33]. Determining the edge of the toad's range is most important, especially for eradication programs or control measures, yet it is this area where toad densities are likely to be lowest and where they are most difficult to detect. For this reason, as is also recommended in the eradication feasibility report [34], it is vital that more sensitive survey methods be immediately tested and employed, such as investigating the use of tracking tunnels, acoustic monitoring, and environmental DNA.

While issues of security limited access to several private courtyards, most residents were helpful and granted access to survey within or through their property at night. Making contact with *Chef Fokontany* during the day prior to conducting surveys and carrying a copy of the permit authorizing our work helped facilitate entry to private property. Access was restricted, however, to several points. Notably, we were unable to conduct surveys on property of the Ambatovy mining operation, including the plant site,

associated residential camps, and the mine tailings site, despite verbal communication suggesting the presence of the toad in these areas, which together encompass a substantial part of the known distribution of the toad. To remedy this, staff from Ambatovy conducted their own visual encounter surveys during June and July 2014 and confirmed reports on their property at a number of sites. While it is helpful to have information from a separate investigation, it will be necessary in the future to better coordinate surveys to ensure that all surveyors use a standard methodology and that data can be managed collectively. Furthermore, if an eradication effort is to be successful it will be essential to avoid splitting work between staff from the eradication program and private entities who may not follow the same protocol or have a background in invasive species removal.

Visual encounter surveys were also limited in that they only involved sites around Toamasina. We did not survey or search for toad populations outside the presumed site of introduction, though it seems possible with the amount of material that is transported out of Toamasina that satellite populations exist undetected elsewhere. Indeed, the toad was reported from the Salambona River in the quarters of Menagisa, Mahanoro more than 200 km south of Toamasina in May 2014, but thus far has not been confirmed, and the report seems somewhat dubious and without evidence [35]. Still, with the amount of trade emanating from Toamasina and the potential for toads to be unintentionally transported, there are likely to be undetected populations in the area outside of our mapped distribution. It is also important to point out that we detected the toad in several sites along the Canal de Pangalanes, a network of rivers and connected manmade waterways that extend more than 600 km southwards along much of the island's eastern coast. Assuming that the toad is able to disperse during its aquatic larval stage, it could potentially move unobstructed along the length of this canal rapidly.

Implications for conservation

Our results reveal that *D*. *melanostictus* is already widespread throughout and to the south and west of Toamasina and that its introduction to Madagascar possibly occurred four years or more prior to the government and scientific community being alerted to its presence. This has major implications for potential eradication or control measures, considering that for the former to be successful every individual toad must be destroyed at a rate faster than their ability to breed and recruit over an area now greater than 100 km^2 [34]. The effort needed would be large, and the strategic and logistical challenges numerous. However, as pointed out in the recent eradication feasibility report [34] for which our distribution surveys were carried out, the consequences to the environment, human population and economy of doing nothing would also be severe and perhaps ethically unacceptable, even if cost and risk of failure are great.

Improving biosecurity at the port to prevent further introductions, both of toads and other potential invasive species, as well as to prevent toads from leaving Madagascar and spreading to other areas, is of utmost importance. An eradication effort cannot be attempted until biosecurity standards are improved [34]. Furthermore, in the likely event that eradication is not successful, it is crucial to improve biosecurity and prevent toads from spreading via exports from Madagascar to other areas of trade. In-country issues of biosecurity also threaten the viability and cost of eradication. Toads could easily be transported unintentionally around the island with goods and freight, and it seems likely they have already done so

within their current distribution through the movement of garbage piles, in and around which toads are abundant.

Kull et al. [36] recently pointed out that invasive species have received far less attention in Madagascar than other threats facing the island's unique biodiversity. The introduction of *D*. *melanostictus* and failure to discover it until it was already widespread throughout Toamasina underscores this point, highlighting the need for conservation organizations and the scientific community to improve efforts to identify and address the threats presented by invasive alien species. With this in mind, we see an opportunity for a coordinated eradication effort to lead to critical methodological and strategic advances for the removal of pest amphibians globally, whilst resulting in improved policies and biosecurity procedures for the country of Madagascar.

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Appendix 1. Results from visual encounter surveys including date surveyed, local site name or description if no name, geographic coordinates of site, and whether or not toads were detected.

Date Surveyed	Site Name	Geographic Coordinates	Toads Detected?
05/07/14	Ambodisaina 1	S18.13924 E49.36588	Yes
05/07/14	Ambodisaina 2	S18.13639 E49.36420	Yes
05/08/14	Farafaty 1	S18.13583 E49.36238	Yes
05/08/14	Farafaty 2	S18.13654 E49.35980	Yes
05/09/14	Antsarimasina	S18.20013 E49.33935	Yes
05/09/14	Tetezantona	S18.15331 E49.35891	Yes
05/12/14	Mangarano	S18.13883 E49.37536	No
05/12/14	Ambodisaina 3	S18.13970 E49.37049	Yes
05/12/14	Barikadimy	S18.13575 E49.37627	Yes
05/12/14	Mangarano 11/47	S18.13394 E49.38105	Yes
05/13/14	Salazamay	S18.12446 E49.40459	No
05/14/14	Mahasoa 4	S18.23097 E49.30518	No
05/14/14	Mahasoa 5	S18.23099 E49.31183	No
05/14/14	Mahasoa 6	S18.23048 E49.31875	No
05/14/14	Mahasoa 1	S18.22894 E49.32541	Yes
05/14/14	Mahasoa 2	S18.22573 E49.33135	Yes
05/14/14	Mahasoa 3	S18.22988 E49.33034	Yes
05/15/14	Tananambo Pont	S18.21243 E49.31049	No
05/15/14	Antanimberika	S18.20995 E49.31498	Yes
05/15/14	Sahavakaka	S18.20348 E49.32453	Yes
05/16/14	Fanandrana Commune	S18.25313 E49.26820	No
05/16/14	Fanandrana Pont	S18.25873 E49.26766	No
05/19/14	Verrerie	S18.16331 E49.39371	Yes
05/20/14	Ankirihiry South	S18.14486 E49.39485	No
05/20/14	Mangarivotra Nord	S18.14989 E49.39322	Yes
05/20/14	MangarivotraSud	S18.15140 E49.39167	Yes
05/21/14	Andranomadio 11/43	S18.12829 E49.38911	No
05/21/14	Unknown 1	S18.13471 E49.38672	No
05/21/14	Mangarano 1 Pres CEG	S18.13951 E49.38381	Yes
05/22/14	Cite Haras 1	S18.13973 E49.39386	No
05/22/14	Cite Haras 2	S18.14857 E49.38961	No
05/23/14	Galana Depot	S18.16688 E49.39981	No
05/23/14	TanandavaAmbodinonoka	S18.17166 E49.32378	Yes
07/01/14	Ambodibonara 2	S18.13973 E49.34658	No
07/01/14	Ambodibonara 3	S18.13942 E49.34190	No

07/01/14	Ambodibonara 1	S18.13980 E49.34828	Yes
07/02/14	Antanimarina 1	S18.12712 E49.36129	No
07/02/14	Antanimarina 2	S18.12284 E49.36139	No
07/02/14	Unknown 2	S18.12711 E49.36136	No
07/03/14	Vohitrambato	S18.11610 E49.33192	No
07/03/14	Vohitrambato Village 1	S18.11610 E49.33192	No
07/03/14	Volotaraina	S18.13070 E49.33639	No
07/04/14	Amboditsipatika	S18.13965 E49.33493	No
07/04/14	TanamakoaAmbanivolo	S18.14015 E49.32502	No
07/05/14	AmbalamanasyCarreaux 4a	S18.09435 E49.38625	No
07/05/14	AmbalamanasyCarreaux 4b	S18.09501 E49.38841	No
07/07/14	Ambalanaomby	S18.21335 E49.28798	No
07/07/14	Antananambo	S18.22035 E49.30034	No
07/07/14	AntananamboMarecage	S18.21582 E49.29337	No
07/07/14	Nambokatra	S18.19974 E49.30272	No
07/07/14	Tsarasaotra	S18.20681 E49.31201	Yes
07/08/14	Ampasimagneva 1	S18.22694 E49.34194	Yes
07/08/14	Ampasimagneva 2	S18.22693 E49.35758	Yes
07/08/14	Ampasimagneva 3	S18.22745 E49.36204	Yes
07/09/14	Antsagabato	S18.24088 E49.32694	Yes
07/09/14	Atserangapetsa	S18.24359 E49.33743	Yes
07/09/14	MahatsaraFonkontany 1	S18.24733 E49.33882	Yes
07/09/14	Mahatsara Pont Machine	S18.23456 E49.32411	Yes
07/10/14	Ambalakondro	S18.06709 E49.37835	No
07/10/14	LyceeagcoleAnalamalotra	S18.06994 E49.38205	No
07/10/14	Road to ParcIvoloina	S18.06672 E49.37297	No
07/11/14	Antanambao	S18.23921 E49.31663	Yes
07/11/14	Masiakamboay	S18.24220 E49.32000	Yes
10/08/14	Ambodizarina 1	S18.14052 E49.31113	Yes
10/08/14	Ambodizarina 2	S18.14044 E49.31727	Yes
10/09/14	Ambalarondra 1	S18.14960 E49.34491	Yes
10/09/14	Ambalarondra 2	S18.15350 E49.34232	Yes
10/10/14	AmbalamanasyCarreux N1	S18.12106 E49.38273	No
10/10/14	AmbalamanasyMarecage	S18.15331 E49.35891	No
10/13/14	Ambavarano	S18.31388 E49.31531	No
10/13/14	Androranga	S18.16236 E49.40318	No
10/13/14	FakoBazarikeky	S18.15468 E49.40297	No
10/13/14	Port fluvial	S18.16578 E49.40114	Yes

10/14/14	Antserangambe	S18.25919 E49.35603	No
10/14/14	Unknown 4	S18.16599 E49.28343	No
10/14/14	AmbonyLavoi 1	S18.26364 E49.34023	Yes
10/14/14	AmbonyLavoi 2	S18.25271 E49.33653	Yes
10/14/14	Canal de Pangalane	S18.18816 E49.37544	Yes
10/14/14	EPP Mahatsara	S18.25386 E49.33136	Yes
10/14/14	MahatsaraFonkontany 2	S18.24627 E49.33915	Yes
10/14/14	Pont Ambatovy	S18.20550 E49.36990	Yes
10/14/14	Unknown 3	S18.13043 E49.37845	Yes
10/15/14	Ambalason	S18.31942 E49.33155	No
10/15/14	Ambatsy	S18.31284 E49.32337	No
10/15/14	Ambodipont	S18.26957 E49.34170	No
10/15/14	Amboditandoho	S18.28061 E49.33525	No
10/15/14	Ambokatra	S18.19246 E49.29621	No
10/15/14	Antanamarina	S18.13082 E49.40111	No
10/15/14	Aucune Village 1	S18.14690 E49.35034	No
10/15/14	Aucune Village 2	S18.14690 E49.35034	No
10/15/14	Cr Amboditandroho	S18.27300 E49.34238	No
10/15/14	Epp/CEG Amboditandroho	S18.28490 E49.33650	No
10/15/14	Tanambao	S18.28244 E49.34122	No
10/15/14	Ambatavia	S18.19786 E49.29832	Yes
10/15/14	Vohitaiza	S18.26231 E49.32789	Yes
10/16/14	Ambodivoapaka	S18.26730 E49.30577	No
10/16/14	Antsirabe 2	S18.24733 E49.29991	No
10/16/14	Nosifasina	S18.26172 E49.32195	No
10/16/14	p/llePalmier	S18.23865 E49.30703	No
10/17/14	Anjinjanaomby	S18.15895 E49.28392	No
10/17/14	Lac	S18.30312 E49.32544	No
10/17/14	Lasy	S18.25588 E49.30381	No
10/17/14	Pampangambo	S18.28613 E49.32463	No
10/17/14	Vohimay	S18.30727 E49.31851	No
10/18/14	Ambokarivo	S18.28533 E49.32468	Yes
11/03/14	Melville	S18.23043 E49.28894	No
11/03/14	Pk 29 RN2	S18.27046 E49.25689	No
11/03/14	Morafeno 1	S18.14626 E49.30676	Yes
11/03/14	Morafeno 2	S18.15126 E49.30281	Yes
11/10/14	Sandrangetana	S18.27860 E49.24806	No
11/10/14	Vohibolo	S18.13883 E49.29419	No

11/10/14	Vohitrambato Village 2	S18.11194 E49.32840	No
11/11/14	Vohimarina 1	S18.15312 E49.29280	No
11/11/14	Vohimarina 2	S18.14839 E49.29143	No
11/12/14	RuisseauxRanomainty	S18.14382 E49.29505	No
11/15/14	Epp Don Ambatoy	S18.16294 E49.28363	No
11/15/14	PauteauxJirama	S18.17482 E49.28520	No
11/15/14	Pistevers Colas	S18.18166 E49.28915	No
11/15/14	PisteversTananambo	S18.15287 E49.28894	No
11/15/14	Antsapanana Colas	S18.21100 E49.31252	Yes