DRUG TRENDS

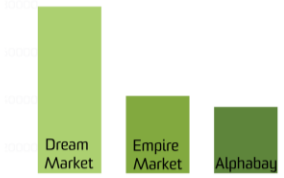
SUMMARY OF MONITORING OF CRYPTOMARKETS FOR DRUG LISTINGS, 1ST FEBRUARY 2014 – 31ST JANUARY 2020

Authors: Anant Mathur, Nicola Man, Raimondo Bruno, Monica J. Barratt, Amanda Roxburgh, Joe Van Buskirk and Amy Peacock
National Drug and Alcohol Research Centre
University of New South Wales Sydney

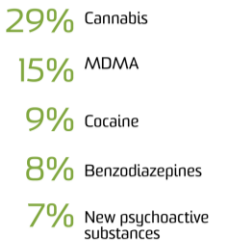
Key Findings

In the period from February 2014 to January 2020, 63 cryptomarkets were monitored.

Between February 2014 and January 2020, 57 cryptomarkets closed down.



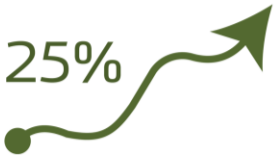
These markets were the largest monitored, with respective peaks of 68,179; 31,620 and 27,115 listings.



Top five drugs across cryptomarket listings from February 2014 to January 2020.

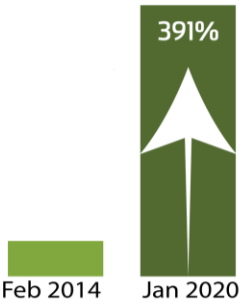
1. **November 2014:** Joint law enforcement operation Operation Onymous results in the seizure of numerous cryptomarkets and servers, including Silk Road 2.0, Cloud Nine and Hydra.
2. **July 2017:** Joint law enforcement operation Operation Bayonet results in the seizure of the cryptomarkets Hansa and AlphaBay.
3. **April 2019:** Dream Market shut down by their own administrators.

Historic purported events that have led to the largest disruptions to cryptomarkets monitored.



On average, there was a 25% increase in the number of drug listings scraped per week in January from one year to the next (2015-2020).

The average number of cannabis listings observed each week increased by 404% from 2,970 in Feb 2014 to 14,964 in Jan 2020.



The average number of MDMA listings observed each week increased by 391% from 1,605 in Feb 2014 to 7,887 in Jan 2020.

- For the period of monitoring 1st February 2014 to 31st January 2020, 63 cryptomarkets were monitored, and 59 cryptomarkets closed down.
- The largest monitored markets were:
  - *Dream Market*: monitored from 1st November 2014 to 28th March 2019 (4 years and 4 months). At its peak, the market hosted 68,179 drug listings and 2,823 vendors (28th March 2019).
  - *AlphaBay*: monitored from 14th February 2015 to 1st July 2017 (3 years and 5 months). At its peak, the market hosted 27,115 drug listings and 1,805 vendors (24th June 2017).
  - *Empire Market*: monitored from 18th April 2019 (ongoing). At its peak, the market hosted 31,620 drug listings and 1,780 vendors (23rd January 2020).

Funded by the Australian Government Department of Health under the Drug and Alcohol Program.

- The average number of cannabis listings observed each week increased by 404% from 2,970 in February 2014 to 14,964 in January 2020. The average number of MDMA listings observed each week increased by 391% from 1,605 in February 2014 to 7,887 listings in January 2020.
- Despite the transient nature of many cryptomarkets, there was a 25% increase, on average, in the number of drug listings scraped per week in January from one year to the next (2015-2020).

Background

This summary reports on trends in the availability and type of substances sold on the internet via cryptomarkets from 1st February 2014 to 31st January 2020.

Drug Trends have identified, crawled (or 'scraped') , extracted, categorised and analysed drug listings on cryptomarkets on a weekly basis since 1st February 2014, formerly using VBA programming processes, and since 9th August 2018 using a range of programmed automated processes in Python that operate with minimal manual input. Further background and information regarding the methods are available for download. It should be noted that data were collected prior to 20th January 2014 however, issues around the regularity of scrapes have meant that we have truncated the time series presented here.

See here for a detailed update on trends over the past year (January 2019-January 2020).

Panel A. Terminology

Cryptomarkets ('darknet markets') are anonymous online trading platforms that facilitate the purchasing of illicit goods and services via multiple sellers.

Number of listings is the sum of listings observed in each weekly scrape, belonging to a specific market or drug class. For this measure, duplicate listings (defined as listings with identical names and same quantity of drug by a single vendor on a single market) within the same week are removed.

Number of vendors is the sum of unique vendors observed in each weekly scrape, selling a specific drug category. For this measure, a vendor is considered unique only within the same market only; that is, the same vendor may be counted multiple times across different markets.

Our reporting focuses only on identified English-language cryptomarkets which have ≥100 drug listings and ≥1 vendor. For a historical record of marketplaces monitored by DNeT, we refer the reader to **Figure 1** or our interactive timeline.

Analyses are concentrated on listings on these marketplaces advertising the sale of illicit drugs (e.g., heroin), key licit drugs (e.g., alcohol, tobacco, e-cigarettes) and pharmaceutical medicines, as well as drug-related paraphernalia (e.g., sterile needles and syringes, reagent test kits).

Following extraction of common text features across each listing (e.g., drug listing name, vendor name and the price in bitcoin or dollars), individual listings are categorised according to a pre-specified classification structure using a rules-based approach through text-matching in the first instance, followed by a long short-term memory (LSTM) artificial neural network (target predictive percentage 90%) that has been trained on historically categorised listings for those not matched through the former process (see methods for full details).

An accompanying public online interactive data visualisation is available, allowing viewers to interact with data collected over the total monitoring period. Data presented here comprise number of listings and number of vendors observed in a given week (see **Panel A**).

These data can be considered reasonable estimates for trends in drug availability, as we cannot guarantee immediate identification and capture of cryptomarkets once they emerge. Further, data provided here can only be used as a proxy of drug availability on cryptomarkets: we have not translated to any metric that reflects the sale volume of a market or specific drug. See here for further discussion of caveats to interpretation.

There are various approaches to collecting, collating, categorising and analysing cryptomarket data, and inherent challenges in these processes. For this reason, we have attempted to be as transparent as possible about our procedures. Our monitoring is an ongoing process, requiring constant refinements to the various stages. We welcome feedback and suggestions so that we can continue to improve utility of these data and our reporting on them (drugtrends@unsw.edu.au).

Profile of Markets

This summary reports for the time period 1st February 2014 to 31st January 2020. At the beginning of the time series, we were monitoring one market (1st February 2014) and by the final week of the time series (31st January 2019) we were monitoring five markets.

The minimum number of markets we have monitored in a given week was 3 (28st November 2019; Cannazon, Empire Market, and Apollon), and the maximum number of markets we have monitored was 16 (12th July 2014; Agora, Evolution, Silk Road 2.0, Pandora, Outlaw, Middle Earth, Cloud Nine, BlackBank, Blue Sky, Hydra, Andromeda, Pirate Market, Tor Bazaar, The Marketplace, Alpaca and 1776).

Across the total period, 63 cryptomarkets were monitored **(Figure 1)**. Of these, 57 markets were closed due to various reasons. Analysis of 89 marketplaces that were operational from 2010 to June 2017 by the European Monitoring Centre for Drugs and Drug Addiction showed that the main reason for market closure was 'exit scamming', where a market site will shut down suddenly, taking the money held in escrows for incomplete orders. Another primary reason was a 'voluntary exit', where a market will close with the mutual consent of those involved, without losses to vendors and buyers. Finally, law enforcement agencies or hackers may decide to target markets and subsequently force their closure.

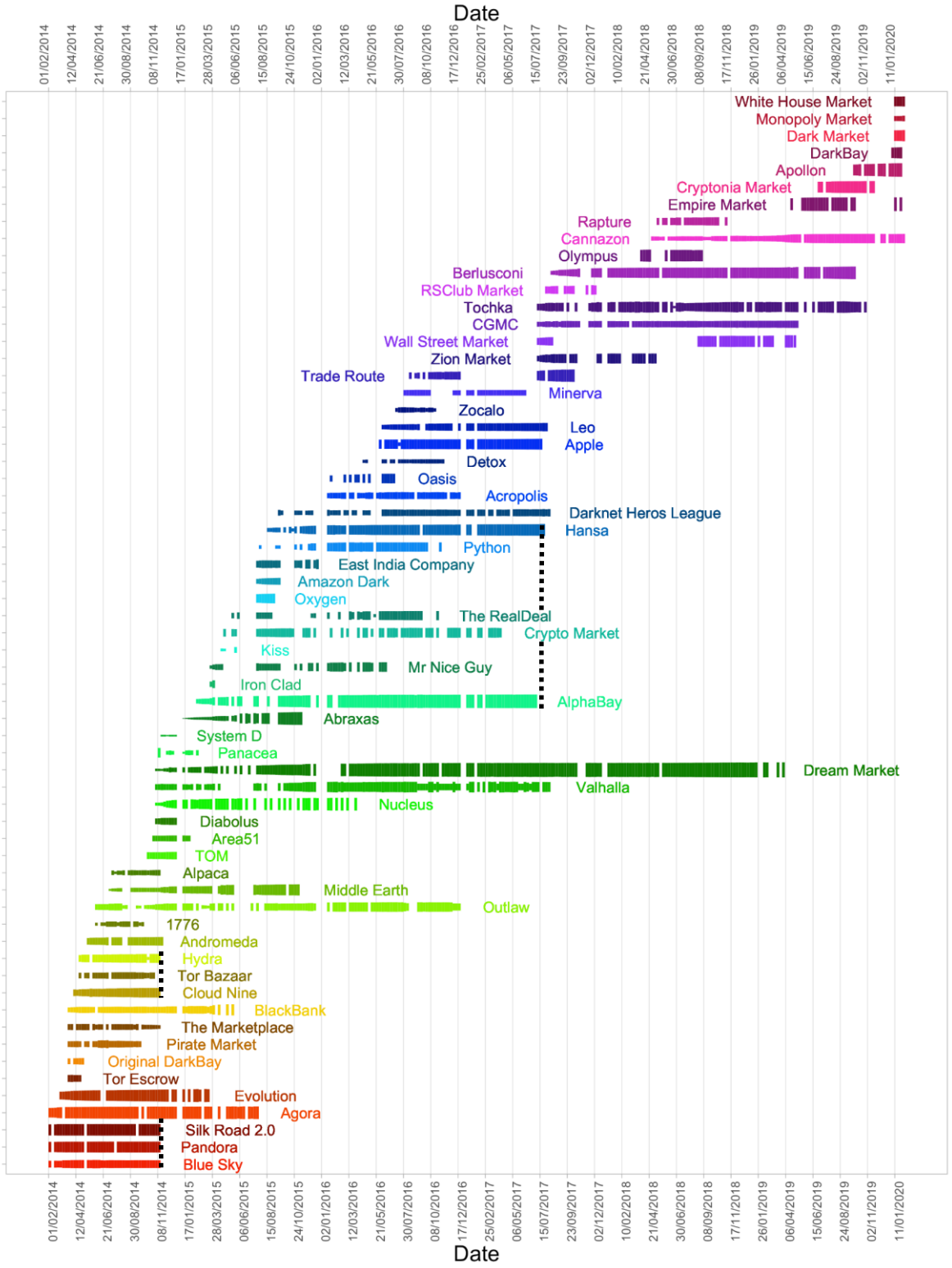
The median duration of monitoring markets was 30 weeks (44.7 standard deviation). The market monitored the longest was Dream Market (230 weeks). Twenty-seven markets were monitored for less than 6 months, highlighting the transient nature of many cryptomarkets.

The median market size (i.e., the number of drug listings observed in a scrape for a single market) was 1,529 across all markets monitored . Most of these markets comprised a relatively small number of market listings; that is, 63% of markets monitored never exceeded a peak of 5,000 drug listings per single scrape. The largest marketplaces comprised the following:

- Dream Market: peak of 68,179 listings on 23rd March 2019, an increase from 24 listings[1] on 1st November 2014 when our monitoring began. This peak occurred on the last scrape before closure.
- Empire Market: peak of 31,620 listings on 23rd January 2020, an increase from 9,474 listings on 18th April 2019 when our monitoring began. This market is currently open.
- AlphaBay: peak of 27,115 listings on 24th June 2017, an increase from 98 listings[1] on 14th February 2015 date when our monitoring began. The market was seized by law enforcement in July 2017 with the last extract (1st July 2017) recording 26,725 listings.

[1]Initial number of listings fall below eligibility threshold (market must display >100 drug listings) because of removal of listing duplications and uncategorized listings.

Figure 1. Markets monitored from 1st February 2014 to 31st January 2020



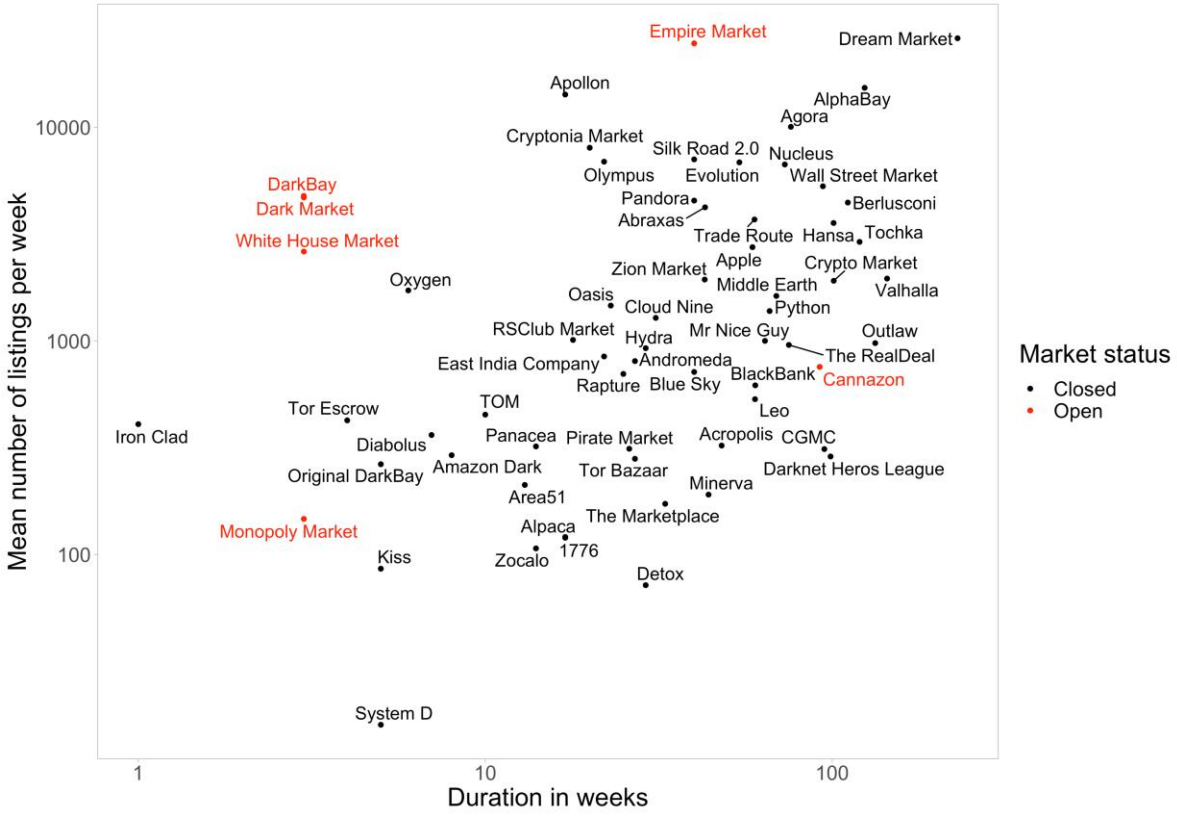
Note: Dashed vertical lines indicate timepoints for Operation Onymous (5th November 2014) and Operation Bayonet (20th July 2017). Breaks indicate time periods where market crawling was not achievable. Width of bar is proportional to log of average listings. The width of the bar is proportional to the log of the number of drug listings observed in each week for each market.

The longevity and size of markets can be determined by the duration of monitoring and the average number of listed drugs per weekly scrape. **Figure 2** displays these two metrics against each other for all monitored markets.

In terms of market size (i.e., the number of listings per scrape for a single market), the median number of listings was 3,027 for the 23 markets that were monitored for more than a year. For the other 40 markets that were monitored for less than a year, the median market size was 1,359, suggesting that the longer a market was online, the larger its market size tended to be. For the largest ten markets in terms of market size, the median monitoring time was 64 weeks (mean of 75 weeks).

Out of the 63 monitored markets, 30 (48%) markets were monitored for less than a year and had a a mean market size less than 2,000 drug listings. Whereas 10 out of the 63 markets (16%) were monitored for more than a year, and had a mean market size greater than 2,000 listings. These statistics suggest that there is a large number of small markets and low number of very large markets. For this reason **Figure 2** displays market size and market longevity on a logarithmic scale. From **Figure 2**, it is evident that Dream Market (top right) had the greatest market longevity and size.

Figure 2. All monitored markets from 1st February 2014 to 31st January 2020 plotted against the duration of monitoring and the mean number of listings per week



Note: Mean number of listing per week and duration in weeks of monitoring is given on a logarithmic scale. Market status (closed/open) was correct as of 30th January 2020.

The following key historic events have led to the largest disruptions to cryptomarkets monitored[2]:

- Operation Onymous: On 6th November 2014, a joint law enforcement operation targeting cryptomarkets was conducted between the FBI and Europol. In the following week numerous markets (and servers) were seized, including: Silk Road 2.0 (maximum 8,073 listings recorded on 11th October 2014), Cloud Nine (maximum 2,179 listings recorded on 8th November 2014) and Hydra (maximum 1,523 listings recorded on 8th November 2014). For more information see Décary-Hétu and Giommoni (2017).

- Operation Bayonet: On 20th July 2017, two major markets, Hansa (maximum 9,306 listings recorded on 21st June 2017), and AlphaBay (maximum 27,115 listings recorded on 24th June 2017), were seized by a law enforcement operation jointly led by the US Federal Bureau of Investigation, US Drug Enforcement Administration and Dutch National Police. For more information see Wegberg and Verburg (2018).

- Dream Market Shutdown: On 4th April 2019, Dream Market administrators announced the pending shutdown of the market on 20th April 2019. In this announcement, Dream Market declared they would move services to a partner market however, the provided onion URL to this marketplace was not operational on 20th April 2019. Due to a period of sustained DDoS attacks resulting in the inability to run relevant automatic scripts, Dream Market was last monitored on 28th April 2019.

While the above key events have had the largest impacts to the number of observed listings **(Figure 3)**, other market closures have caused disruptions. Notable disruptions from purported market exit scams include the closure of Evolution (last monitored 14th March 2015), Nucleus (last monitored 26th March 2016) and Wall Street Market (last monitored 26th April 2019).

Market Size

At the beginning of the time series, we identified 11,308 drug listings across four markets (1st February 2014) and by the final week of the time series (31st January 2020) we identified 41,880 drug listings across five markets. The minimum number of listings we have scraped on a single occasion was 11,308 (1st February 2014), and the maximum number of listings we have scraped on a single occasion was 86,424 (28th April 2019).

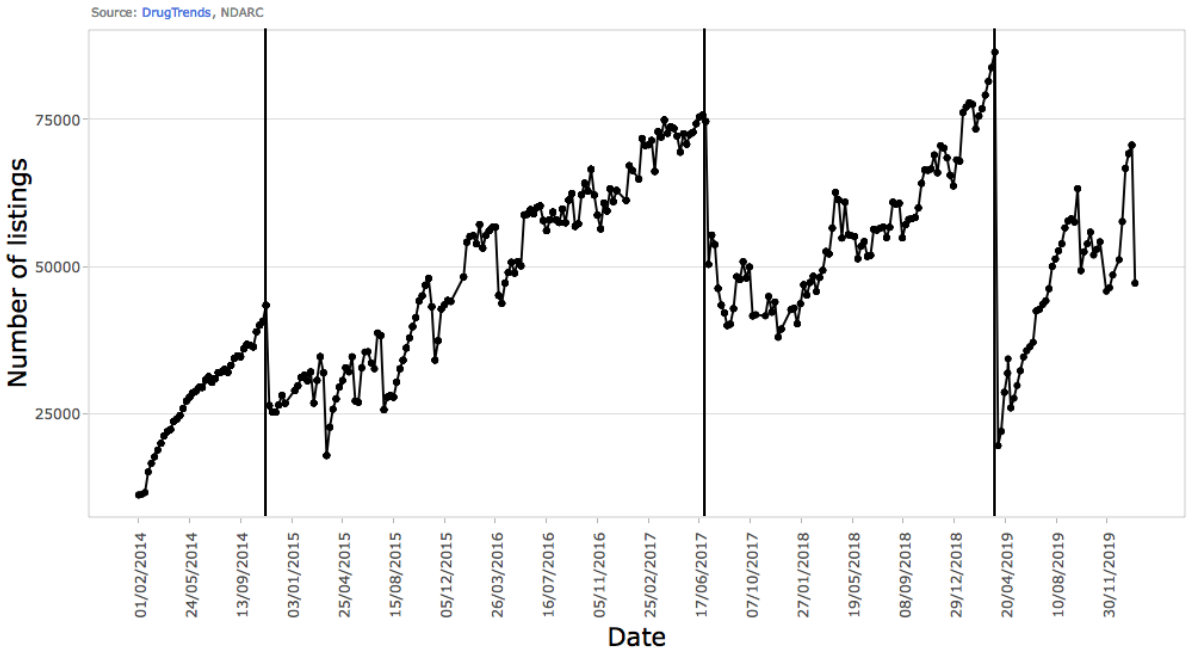
[2]Internet sources for purported closures hyperlinked on market name.

There have been significant fluctuations in the number of listings per week observed over time. The three key events identified above have underpinned some of the most significant shifts:

- The seizure of Silk Road 2.0, Cloud Nine, Hydra and other smaller markets due to Operation Onymous (5th November 2014) resulted in a drop in the number of listings, from 42,763 listings across 20 markets monitored in the week of 8th November 2014 versus 26,471 listings (38% reduction) across 14 markets in the first week following cessation (15th November 2014).
- The seizure of AlphaBay and Hansa due to Operation Bayonet (20th July 2017) resulted in a drop in the number listings, from 74,763 listings across 8 markets monitored in last week of monitoring which included both AlphaBay and Hansa (1st July 2017) versus 46,348 listings (38% reduction) across 10 markets in the first week following Operation Bayonet (27th July 2017). Note, the number of monitored markets increased due to initial monitoring of smaller markets.
- The shutdown of Dream Market resulted in a drop in the number of listings, from 86,424 listings across six markets monitored in final week of monitoring (28th March 2019) versus 22,089 listings (74% reduction) across five markets in the first week following cessation (4th March 2019).

In saying this, there was a 25% increase, on average, in the number of drug listings scraped per week in January from one year to the next (2015-2020). This increasing trend from year to year is observable in **Figure 3.**

Figure 3. Number of drug listings observed across all markets monitored from 1st February 2014 to 31st January 2020



Note: Line displays the total number of drug listing across all markets monitored at a given time. Caveats to this metric are outlined in the methods. Dashed vertical lines indicate timepoints for Operation Onymous (5th November 2014), Operation Bayonet (20th July 2017) and Dream Market shutdown (4th April 2019).

This crude analysis would suggest that market interruptions do not have sustained impacts on total market size across all cryptomarkets, with recovery in total number of listings normally observed within six to twelve months. We are undertaking further formal analyses of this hypothesis and direct the reader to work by van Buskirk et al. (2017) and Décary-Hétu and Giommni (2017), as well as other literature on this topic.

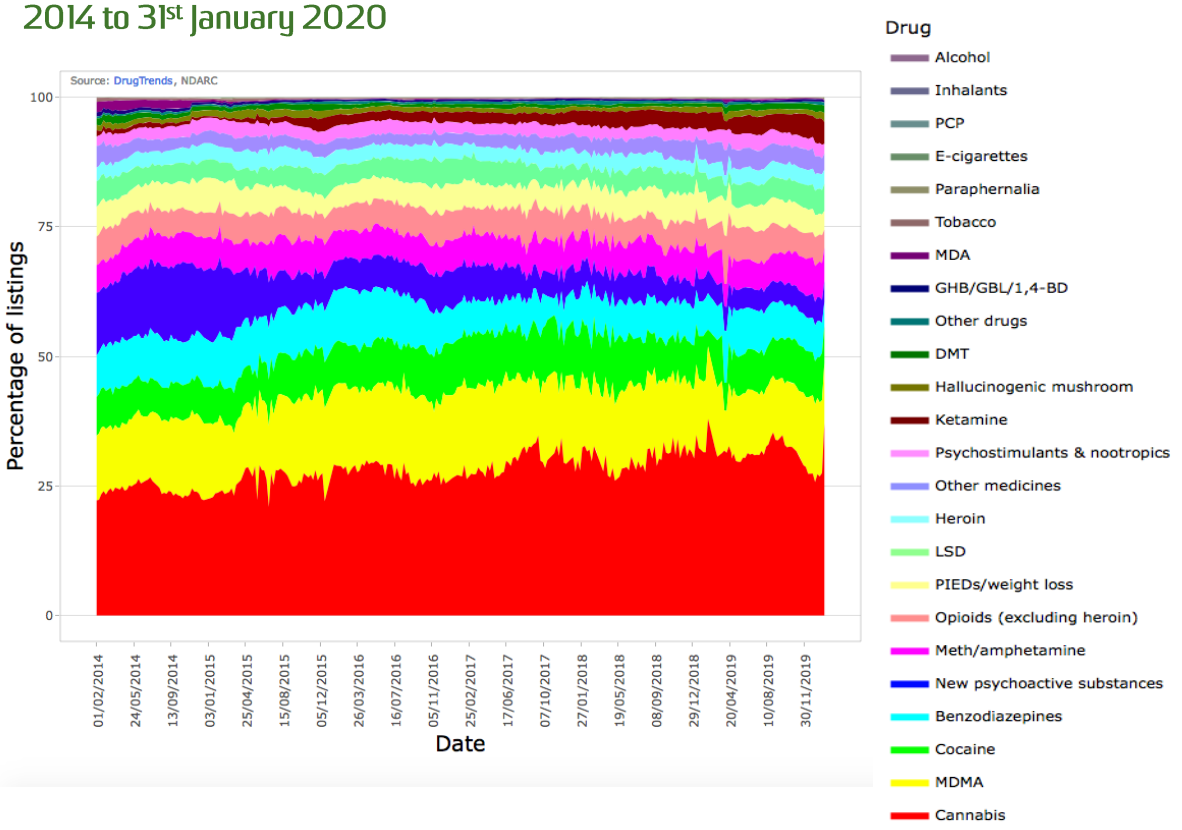
Substance Availability

Market listings captured through cryptomarket monitoring have been categorised into drug classes according to this methodology.

Cannabis comprised the bulk of the listings identified across all markets over the total period of monitoring (28.8%), followed by MDMA (14.8%), cocaine (8.7%), benzodiazepines (7.7%), new psychoactive substances (6.6%) and meth/amphetamine (5.9%) (see **Table 1** and **Figure 4**).

As evident from these figures, illicit substances (e.g., cannabis, MDMA, cocaine) comprised 52.3% of substances listed on cryptomarkets. While new psychoactive substances were the fifth most common drug class identified, challenges in their categorisation must be noted (see methods for further detail).

Figure 4. Percentage breakdown of listings by drug class over time from 1st February 2014 to 31st January 2020

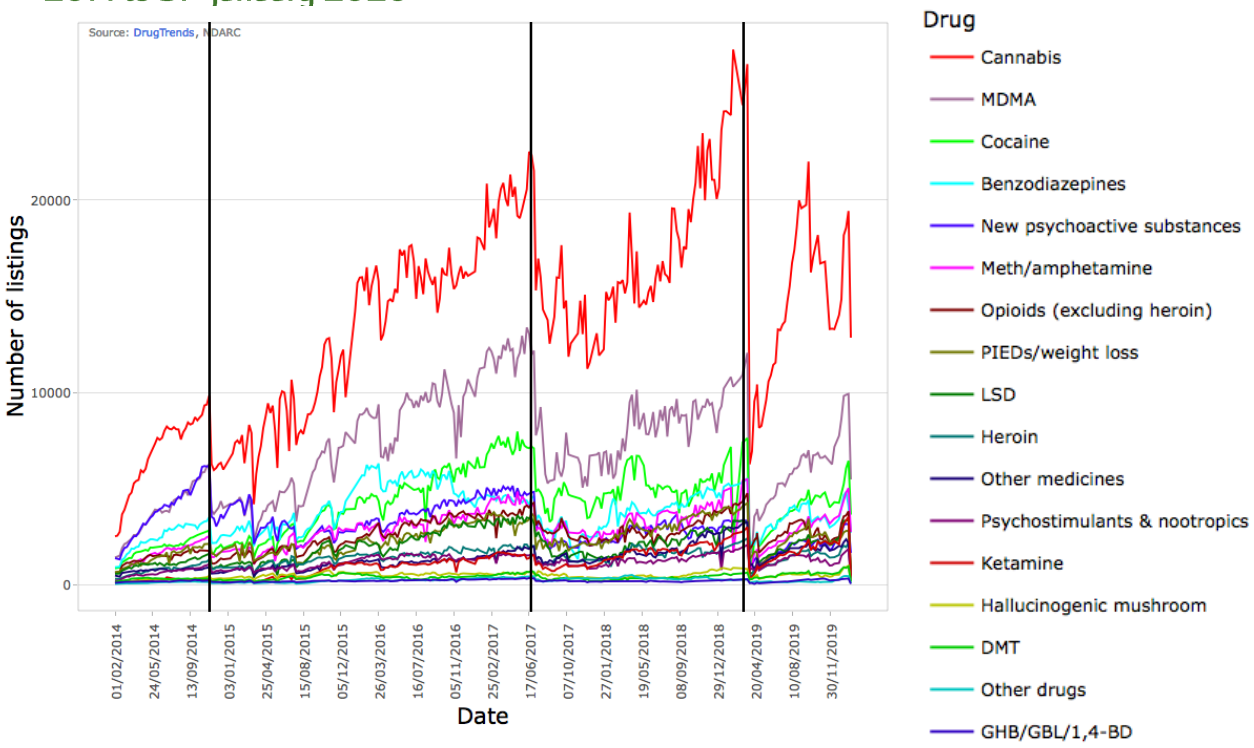


Note: Data has been interpolated for missing data See here for information on how interpolated data were computed. To view these data, see our interactive visualisation.

In terms of *market share*, there have been relatively small fluctuations in the percentage of all drug listings accounted for by each drug (see **Table 1** and **Figure 4**). This suggests that the market share for the broad substance categories available on cryptomarkets remains relatively stable. When comparing the percentage of all listings observed in February 2014 and January 2020, the greatest magnitude of change were for NPS (-8.9%) and Ketamine (+4.0%). Analyses are planned to determine impacts of the abovementioned major events on the substances available via cryptomarkets. Reporting on specific substances will be expanded in future via these bulletins and our online visualisation.

Comparison of the number of listings for each drug over time (i.e., the *market size* for each drug; see **Figure 5**) shows growth across all drug classes, reflecting the general increase in listings from February 2014 to January 2020.

Figure 5. Number of listings disaggregated by drug for all markets from 1st February 2014 to 31st January 2020

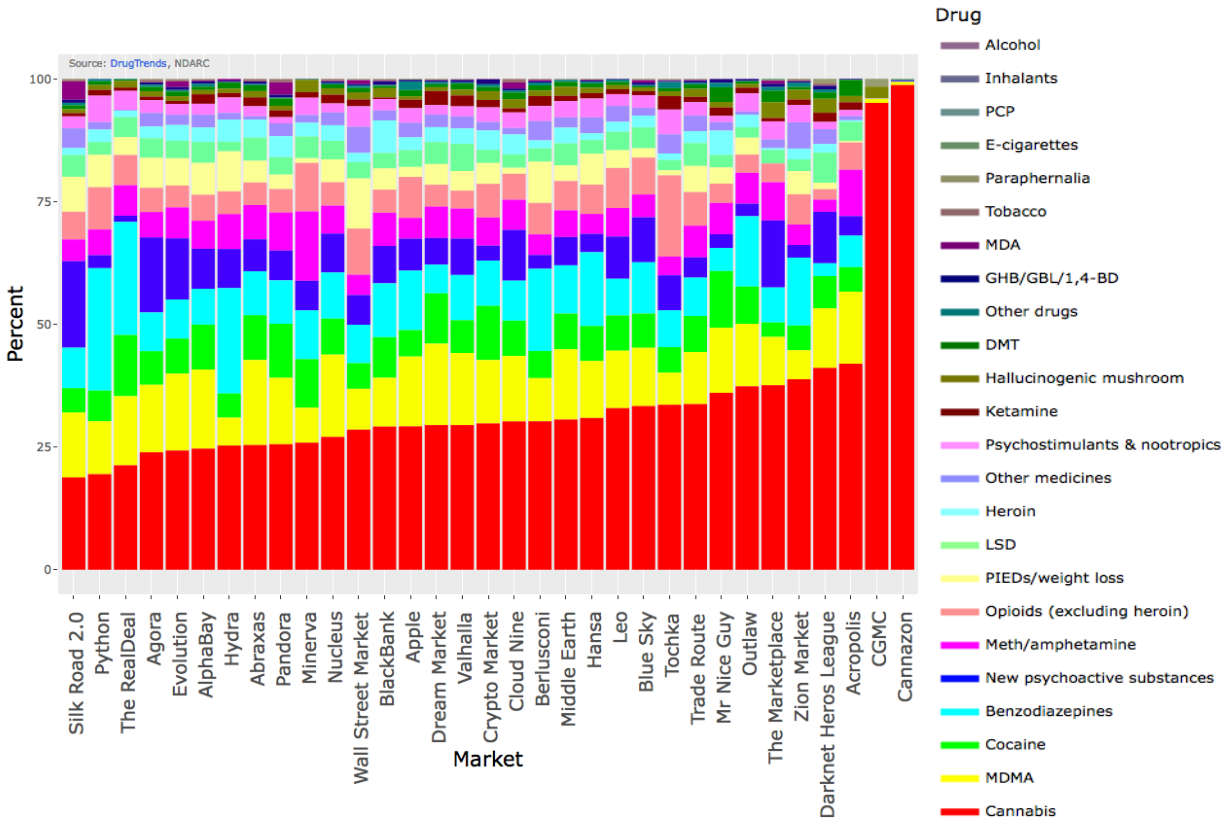


Note: Data has been interpolated for missing data See here for information on how interpolated data were computed. MDA, tobacco, paraphernalia, e-cigarettes, PCP, inhalants and alcohol have not been included in the figure. To view these data, see our interactive visualisation. Dashed vertical lines indicate timepoints for Operation Onymous (5th November 2014), Operation Bayonet (20th July 2017) and Dream Market shutdown (4th April 2019).

The greatest increase in market size was observed for cannabis (2,970 listings in February 2014 versus 14,965 listings in January 2020; 404% increase), followed by MDMA (1,605 listings in February 2014 versus 7,887 listings in January 2020; 391% increase). It should be noted that three of the 63 markets we have monitored have comprised >90% cannabis listings (median 280 listings for these markets; see **Figure 6**).

Figure 6 shows the breakdown of listings by drug type per market, for markets monitored for more than six months. These analyses show that most markets monitored listed an array of different drugs, although listings for two cannabis specific markets (CGMC and Cannazon) comprised >90% cannabis. There was also variability in the market share attributed to each drug across markets. For example, on Silk road 2.0 the market share of new psychoactive substances was 18%, whereas for The RealDeal it was only 1%. For benzodiazepines, Python had a market share of 25%, whereas Darknet Heros League only had a 3% market share.

Figure 6. Drug composition of markets monitored for more than 6 months, 1st February 2014 to 31st January 2020



Note: See Figure 1 and our interactive timeline for the duration of monitoring each market. This figure displays the percentage of all listings attributed to each drug class from 1st February 2014 to 31st January 2020) for each marketplace monitored for more than 6 months. Missing data are interpolated in this figure. See here for information on how interpolated data were computed.

Table 1. Market share change of total listings by drug class from 1st February 2014 to 31st January 2020

	% total listings[a]	Market share % change[b]						
Drug Category	**Feb 14 – Jan 20**	**Feb 14 – Jan 20**	**Feb 14 – Jan 15**	**Jan 15 – Jan16**	**Jan 16 – Jan 17**	**Jan 17 – Jan 18**	**Jan 18 – Jan 19**	**Jan 19 – Jan 20**
Benzodiazepines	7.7	-0.2	2.3	1.0	-3.4	0.1	-	-0.2
Cannabis	28.8	0.8	-3.2	5.8	-2.1	2.2	3.1	-5.0
Cocaine	8.7	2.5	1.1	1.2	1.4	0.8	-2.1	0.1
DMT	0.8	-0.6	-1.1	0.3	-0.4	-0.3	0.3	0.6
GHB/GBL/1,4-BD	0.4	-0.4	-0.3	-0.1	0.1	-0.1	-0.1	0.1
Hallucinogenic mushroom	1.0	0	-0.1	-0.1	-0.2	-0.1	0.3	0.2
Heroin	2.8	0.6	0.5	-	-0.2	0.2	-0.4	0.5
Ketamine	2.3	4	-0.4	1.7	-0.2	0.7	0.5	1.7
LSD	4.1	-1.6	-2.0	0.4	0.9	-1.6	0.6	0.1
MDA	0.2	-0.5	-0.2	-	-0.2	-0.1	-	-
MDMA	14.8	0.1	-0.4	1.7	0.7	-0.9	-1.9	0.9
Meth/ amphetamine	5.9	2	1.1	-0.1	-	0.4	0.1	0.5
New psychoactive substances	6.6	-8.6	0.6	-8.2	1.6	-2.1	-0.8	0.3
Opioids (excluding heroin)	5.2	-0.1	-0.3	-0.6	1.1	-0.2	-0.1	-
Other drugs	0.5	0.2	-0.1	0.2	-	0.2	-0.4	0.3
Other medicines	2.7	0.3	-0.4	-0.3	-0.1	0.9	0.3	-0.1
Paraphernalia	0.1	0.1	0.1	-0.1	0.1	-	0.1	-0.1
PCP	-	-0.1	-0.1	-	-	-	-	-
PIEDs/weight loss	4.9	-0.2	2.1	-2.3	1.1	-0.2	0.4	-1.3
Psychostimulants & nootropics	2.4	0.6	0.7	-0.1	-0.4	0.1	-0.1	0.4

Note: Alcohol, e-cigarettes, tobacco and inhalants not shown due to small values. – Per cent suppressed for values <0.05. All values in table have been calculated using interpolated data. See here for information on how interpolated data were computed. [a]This column displays the percentage of total listings across all marketplaces observed from 1st February 2014 to 31st January 2020. [b]These columns display the change in percentage of total listings attributed to each drug across all marketplaces in the stated months (e.g., from January in one year to January in the next year). Refer to historical timeline for the monitored markets in the relevant months used in comparison. PIEDS: performance and image enhancing drugs.

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Related Links

- Data visualisations: https://drugtrends.shinyapps.io/cryptomarkets
- Methods document: https://ndarc.med.unsw.edu.au/resource/methods-trends-cryptomarket-drug-listings
- For more research from the Drug Trends program go to: https://ndarc.med.unsw.edu.au/program/drug-trends

Contact us

Email: drugtrends@unsw.edu.au