I. ECOMONITORING

IMPLEMENTATION OF BALLAST WATER MANAGEMENT CONVENTION – A STEP IN SAVING THE BLACK SEA ECO SYSTEM

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Abstract: Marine ecosystems are under increasing anthropogenic pressures from marine and terrestrial activities. Shipping forms a network that spans the globe and introduces many economically and environmentally harmful invasive species, including human diseases such as cholera. Ship traffic, the major cause of change in the open ocean, and its temporal evolution are still largely unknown.

Since the 1960s the Black Sea has undergone dramatic environmental changes. These changes are considered as result from a complex interaction of different pressures, the most important being eutrophication, overfishing and introduction of alien species.

Some nations, and the International Maritime Organization, are moving towards requirements for managing ballast water to reduce the number of alien species transported and released.

Key Words: Ballast Water Management, Alien Marine Species, Black Sea Eco System

I. INTRODUCTION

Under human influence, plants, animals, and sea life are spreading beyond their native ranges faster and farther than ever before. Rates of invasion are increasing worldwide, especially in large aquatic systems [1]. Many of these alien species appear to be innocuous, whereas others cause substantive impacts on biodiversity, ecosystem services, and human and animal health [2]. Effective management requires an ability to anticipate and prioritize significant invasion threats from among the enormous numbers and diversity of organisms introduced by transportation mechanisms that facilitate human travel and trade, such as shipping. Global ship traffic has increased by fourfold since the early 1990s [3]. Shipping is the dominant vector of unintentional species introduction in estuarine and coastal marine systems worldwide, and connects distant regions using ports as stepping stones [4,5].

More than 1,000 alien marine and coastal species have been recorded in Europe [6]. Most have established self-sustaining populations of long duration, whereas some have been known from ephemeral populations of short duration.

Non-indigenous aquatic species are of primary concern to many regulating authorities and are seen as one of the top four anthropogenic threats of the world's oceans. Intentional and accidental species introductions have often resulted in their establishment outside the native ranges. Introduced species have the potential to alter environments and may cause the loss of earnings [7]. It is generally assumed that the key introduction vectors are

unintentional transport by ships and intentional importations of aquaculture target species as well as accidental releases from aquaculture sites.

A subset of the established alien species, which have spread, are spreading or have demonstrated their potential to spread elsewhere and have an adverse effect on one or more of the following: biological diversity, ecosystem functioning, socio-economic values or human health in invaded regions, are termed invasive alien species (IAS).

IAS are considered as one of the key causes of biodiversity changes worldwide. The impacts of IAS are immense, sometimes disastrous and usually irreversible. Some invaders are re-forming the structures, dynamics or functions of aquatic communities, or are imposing significant economic costs. In monetary terms, it was recently calculated that the lost output due to all aquatic IAS, health

impacts and expenditure to repair IAS damage costs EU stakeholders more than 100 million EUR per year [8]. The global rate of new aquatic invasions increased in recent years, which amplifies the concerns. This was noted also by the United Nations and IAS are categorized as one of the top four anthropogenic threats of the world's oceans.

It is expected that the EU Strategy on Invasive Alien Species will significantly help to reduce the future IAS impacts. Considering the IAS related costs, the implementation of this EU strategy will outweigh the associated costs. Other instruments to minimize the risk of species introductions include the IMO Ballast Water Management Convention, IMO biofouling guidelines for recreational and commercial vessels and quarantine procedures in

aquaculture. In consequence rules and regulations exist to reduce the IAS problem, they simply need to be followed.

No habitat is immune to invasions. All coastal waters of Europe are inhabited by at least one alien species. Some habitats, such as lagoons and ports serve as “hot spots” and “nodes” of invasion and some regions are more invaded than others.

Black Sea region on the other hand is also affected by the world shipping process. Invasive species threaten local sea life and littoral countries economic.

II. BIOINVASION IN THE OCEAN WORLDWIDE

Alien species are those species which are not native to an area as they were intentionally or unintentionally introduced. Possible vectors or so call “transfer mechanisms” of aquatic species are:

- shipping (ballast water and biofouling);
- canals;
- small craft;
- intentional stocking;
- release from aquaria;

- release of organisms intended for human consumption;
- release of bait species;
- intentional and unintentional aquaculture introductions;
- discharges of wastes following fish processing;
- transport of fishing gear.

First Canadian Government rose alarm in the second half of twentieth century for dramatic changes in the Great Lakes eco system [1]. The Laurentian Great Lakes basin has been invaded by at least 182 non-indigenous species. A new invader is discovered every 28 weeks, which is the highest rate recorded for a freshwater ecosystem. The non-indigenous species have invaded the Great Lakes basin since the year 1840. Over 40% of these invaders were discovered since the opening of the St. Lawrence Seaway in 1959. Consequently, there has been a nonlinear accumulation of nonindigenous species in the Great Lakes over the past two centuries (Fig. 1).

Fig. 1. Cumulative number of invaders in the Great Lakes between 1840 and 2010

The relative abundance of invading plants, algae, invertebrates, and fishes has changed markedly with time, largely in concordance with changes in vector activity. Over the past 100 years, invasions caused by mechanisms of deliberate

release (e.g. via fish stocking or plant cultivation) have declined, whereas shipping-related invasions and modes of unintended release have increased (Fig. 2) [9].

Fig. 2. Vectors attributed to Great Lakes invasions since the year 1840

Invasions attributable to shipping vectors have increased with shipping activity during the 20th century. Shipping activity peaked during the latter half of the century, and during this time invasion by vascular plants diminished, while those of aquatic

invertebrates and algae increased (Fig. 3); 65% of all invasions recorded since the opening of the St. Lawrence Seaway in 1959 are attributable to ballast water release. A linear accumulation of ship-vectored invaders is recorded from 1960 onwards.

Fig. 3. Changes in the taxonomic composition of Great Lakes invaders since the year 1840

Globalization increases opportunities for species to move beyond their natural biogeographical barriers. As demand for trade, travel and transport

has expanded within the EU and with the rest of the world, the rate of intentional and unintentional introductions of new species has risen exponentially

in recent decades (Fig. 4 and 5). Calculations made on 995 species for which the first record is precisely known. The numbers above the bars correspond to

the number of new species recorded per period [10, 11]. This trend is predicted to continue, along with the further spread of already established species.

Fig. 4. Trends in established alien terrestrial invertebrates in Europe since 1492

Fig. 5. Rate of arrival of alien mammals per year in Europe in four periods: 1500-1800; 1800-1950; 1950-2000; and 2000-2005

Many introduced species are of critical importance for production systems that underpin European economies. They provide a range of employment opportunities and are highly appreciated in society (e.g. ornamental plants, pet animals, exotic birds, game, fish for angling and aquaculture). However, the subset of introduced species that have become invasive in Europe generate a range of negative economic, social and

environmental impacts that can also be measured in monetary terms and may outweigh their benefits.

Looking to the sea many IAS can be found as invaders with negative effect for the ecology and economics. The reason of their establishment in European sea waters is the world trade and the shipping as a main transportation factor.

Statistic says that about 180 alien marine multicellular species have been recorded in the western Mediterranean Sea, approximately 120 alien

species are recorded in the Baltic Sea with around seventy of them being established and only a few causing severe problems, more than 150 alien species were so far recorded from the North Sea and its adjacent estuaries. The majority of those are assumed to have been introduced by shipping and aquaculture activities. In shipping the pathway biofouling prevails the ballast water mediated species introductions. During the last decades, in average two new alien species are reported from the North Sea annually [12, 13].

III. BIOINVASION IN BLACK SEA

The Black Sea is an inland semi-enclosed basin. With more than 80% of its waters being anoxic with a high content of hydrogen sulphide, the Black Sea contains the largest mass of lifeless water on Earth. Marine life is concentrated in the upper oxygenated layer, and the continental shelf situated above the limit of anoxia hosts abundant bottom life.

The Black Sea has since the 1960s undergone dramatic environmental changes. These changes are thought to result from a complex interaction of different pressures, the most important being eutrophication, introduction of alien species and overfishing.

Among all the species accidentally introduced in the Black Sea, the invasion of the ctenophore (comb jelly) *Mnemiopsis leidyi* was one of the most devastating biological explosions ever recorded, and

resulted in major changes in the structure of the ecosystem. With no predators to control its abundance, *Mnemiopsis* spread suddenly through the Black Sea and contributed to the collapse of the Black Sea fisheries through food competition and direct predation on fish larvae. The levels of *Mnemiopsis* were subsequently reduced by the introduction of one of its predators, the ctenophore *Beroe ovata* [14].

The number of registered alien species at the regional level amounts to 217 (parasites and mycelium excluded). Nearly half of them (102) are permanently established. This high ratio of invasive aliens suggests a serious impact on the Black Sea native biological diversity, with negative consequences for human activities and economic interests. Between 1996 and 2005 a total of 48 new alien species were recorded, which represents over 22% of all registered aliens. The majority belong to phytoplankton (16) and zoobenthos (15), followed by zooplankton (8), fish (5), macroalgae (3) and mammals (1) [15]. Some of these alien species have had a high predating effect, such as the Japanese sea snail *Rapana venosa*, which decimated the mussel stocks. The invasion of the ctenophore (comb jelly) *Mnemiopsis leidyi* was one of the most devastating biological explosions ever recorded, and resulted in dramatic changes in the structure of the ecosystem. It is another example for Bioinvasion caused destructive effect.

Table 1. Invasion status of introduced species according to the European Seas considered (including adjacent waters)

Region	Number of established species	Number of unestablished species	Number of cryptogenic species	Number of extinct species	Number of species with unknown invasion status	Total number	Total percent
Mediterranean Sea	325	116	23	No data	198	662	46.8
North Sea	144	9	16	4	57	230	16.2
Atlantic coast	112	19	5	2	39	177	12.5
Baltic Sea	99	1	15	5	50	170	12.0
Black Sea	61	9	3	No data	10	83	5.9
Azores	24	No data	No data	No data	1	25	1.8
Irish waters and NW UK	39	3	4	No data	5	51	3.6
Arctic waters	10	1	1	No data	6	18	1.3
Total	814	158	67	11	366	1,416	100.0

Western part of Black Sea is a part of European waters. The following data makes comparison

between invasive alien species quantity in Black Sea waters and the rest European seas.

The regional invasion pattern in European seas is very different. The highest number of introduced species was found in the Mediterranean Sea (662 taxa of which 325 are considered to be established). The lowest number of invaders is documented from European Arctic waters (18 species) (Table 1) [16]. In percent of all introduced species the Mediterranean Sea hosts most taxa with 46.8% followed by the North Sea with 16.2%. The lowest number of invaders of the seas considered is found in the European Arctic waters (1.3% of all non-indigenous species found) (Table 1).

IV. IMPLEMENTATION OF THE BALLAST WATER MANAGEMENT CONVENTION

Ballast is any material used to weigh down and/or balance the ships. It helps in submergence of propeller and rudder for steerage. For thousands of years, ships carried rocks and/or metal as solid ballast. Ships of modern times use sea water for ballasting. When a ship empties its cargo, it takes in water as ballast to maintain its stability and structural integrity. Conversely, when it loads cargo, the ballast water is discharged usually in the vicinity of ports just prior to loading the cargo from an exporting country. Sea water loaded for ballast purposes contains a gamut of organisms and their propagules. In the wild, natural processes control their sustenance. However, their hostage status in the dark ballast waters leads to alterations in physiological and population structure of these organisms.

The analyses from above impose the conclusion for the shipping great role in transferring of alien species. Invasive aquatic species are one of the four greatest threats to the world's oceans, and can cause extremely severe environmental, economic and public health impacts. The Great Lakes Administration was the first who introduced restrictions in ships ballast water operations in order to prevent local nature from invaders.

Since May 1993, ships have been required to exchange their freshwater or estuarine ballast with highly saline oceanic water prior to entering the Great Lakes [17], a procedure termed 'ballast water exchange' (BWE); the regulation was preceded by voluntary guidelines issued by Canada in 1989 [18] and the USA in 1991. In theory, an open-ocean BWE should greatly reduce the risk of invasion as freshwater organisms in ballast tanks would be purged or killed by the highly saline water and be replaced by marine organisms that cannot survive

and reproduce if released into the Great Lakes. In practice, open ocean BWE does not remove all coastal and inland-water taxa from ballast tanks, although it may reduce the numbers of live individuals [19]. Furthermore, BWE often achieves only brackish salinities because residual freshwater usually remains in the tanks, due to the position of the pump intakes [20]. Therefore, conditions produced by BWE might not be intolerable to organisms adapted to a broad salinity range.

The vectors shipping, aquaculture and stocking may play a different role in the future as regulatory instruments are either in place or developing to minimize the number of new species introductions. In aquaculture and stocking, the International Council for the Exploration of the Sea (ICES) has updated its Code of Practice for the Introductions and Transfers of Marine Organisms. This instrument provides (voluntary) guidelines to avoid unwanted effects of moved species and unintentional introductions of non-target species [21]. The International Maritime Organization (IMO), the United Nations specialized agency responsible for world shipping and minimizing pollution from ships, has developed two conventions relevant to biological invasions. One is the International Convention on the Control of Harmful Anti-fouling Systems on Ships. This convention was developed noting the unwanted impact from poisonous antifouling paints based on Tributyl-tin (TBT) in the aquatic environment. Consequently, the use of TBT was banned. TBT-free antifouling paints are currently being developed and tested. However, it is suggested that alternative ship coatings may not be as effective, possibly resulting in more species being transported on the ship's hull.

The second convention prepared by IMO is the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Here, ballast water exchange in open seas is recommended as an intermediate solution to minimize the number of species in transit. As a second step, ballast water treatment will be required knowing that ballast water exchange is of limited efficacy. This convention was adopted in 2004. It was ratified by a sufficient number of states on 8 September 2016, bringing the total gross tonnage to over 35% from the signatory states. This means the convention will enter into force 12 months later, on 8 September 2017. This news describes consequences for the shipping industry and recommendations to ship owners. The overall purpose of the Ballast Water Management (BWM)

Convention is to prevent the transport of invasive species from port or area A to port or area B and thus prevent the destruction of marine habitats.

The Convention requires each relevant vessel to carry an International BWM Certificate, issued by the flag state. The vessel shall have this certificate on board by 8 September 2017 at the latest. The BWM Convention includes a transitional period during which ballast water can be “exchanged” in deep seas during voyages between ports A and B. The BWM Plan shall describe how this is done.

Eventually all relevant vessels shall have installed a Ballast Water Treatment System (BWTS), whereby ballast water discharged is made harmless related to invasive species. The IMO implementation schedule for BWTS implies “first International Oil Pollution Prevention (IOPP) renewal survey after the entry into force of the Convention” at the latest. This implies that most vessels (which do not already have a BWTS installed) will be requested to install such equipment in the period 2017–2021 – in each case before the expiry date of the vessel’s IOPP certificate.

All ships of 400 gross tones (GT) and above will be required to have on board an approved Ballast Water Management Plan and a Ballast Water Record Book, and to be surveyed and issued with an International Ballast Water Management Certificate.

For ships whose flag administration has not ratified the BWM Convention a certificate or statement of compliance can be issued.

Parallel to International Regulations United States Coast Guard has issued regulations for all ships visited American ports. The regulations say that “All ships calling at US ports and planning to discharge ballast water must carry out ballast water exchange or treatment in addition to sediment management” [17]. European Union has also established regulations in this matter. EU Regulation 1143/2014 on invasive alien species entered into force on 1 January, 2015 and “seeks to address the problem of invasive alien species in a comprehensive manner so as to protect native biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that these species can have” [22].

For Bioinvasion prevention of seas BWM Convention prescribe two basic regulations:

– D-1 – ships performing Ballast Water exchange in accordance with this regulation shall do so with an efficiency of at least 95 percent volumetric exchange of Ballast Water;

– D-2 – ships conducting Ballast Water Management in accordance with this regulation, D-2 Standard, shall discharge ballast water with quantity according to the values in table 2 [23].

Table 2. The IMO D-2 standard for discharged ballast water

Organism category	Regulation
Plankton, >50 µm in minimum dimensions	<10 cells/m ³
Plankton, 10-50 µm	<10 cells/ml
Toxicogenic <i>Vibrio cholera</i> (O1 and O139)	<1 colony forming unit (cfu)/100ml or less than 1cfu/g (wet weight)
<i>Escherichia coli</i>	<250 cfu/100ml
Intestinal Enterococci	<100cfu/100ml

Understand the obligations under the BWM Convention and other national and local regulations the ship owners and ship’s Masters need to:

– ensure all ballast discharges comply with regulation D-1 or D-2, i.e., that ballast is exchanged or treated: this obligation applies to ballast discharges both at sea and in port;

– ensure the procedures in the Ballast Water Management Plan are followed at all times;

– keep proper records in the Ballast Water Record Book;

– operate and maintain ballast water treatment systems in accordance with the manufacturer’s instructions.

Although most deep water ships are expected to comply by installing a fixed ballast water treatment system on board, a number of ships will choose to comply by using one or more of the alternative methods shown in Fig. 6 (*Ballast Water Treatment System) [24]. It should be noted that the USCG only accepts municipal water from North American supplies. However, this is not currently accepted under the BWM Convention, although it is under discussion.

The technologies used for treating ballast water are generally derived from municipal and other industrial applications. However, their use is constrained by key factors such as space, cost and

efficacy (with respect to the IMO discharged ballast water standards). There are two generic types of process technology used in ballast water treatment:

- solid-liquid separation, and
- disinfection.

Fig. 6. Alternative methods of compliance

Some treatment systems use or generate one or more active substances which are used in the treatment process. In addition, some systems require a neutralizer to be used to ensure that on discharge of ballast any residues of the active substance used in the treatment process are made safe.

The Materials Safety Data Sheet and manufacturer's recommendations should also be obtained for:

- handling and storage of chemicals;
- crew safety and emergency procedures in the event of a spill, fire or explosion;
- appropriate first aid measures in the event of chemicals coming into contact with the skin or being.

V. CONCLUSION

After more than 14 years of complex negotiations between IMO Member States, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted. At a Diplomatic Conference held at IMO Headquarters in London on 13 February 2004 the Secretary-General of IMO stated that the new Convention will represent a significant step towards protecting the marine

environment for this and future generations. "Our duty to our children and their children cannot be over-stated. I am sure we would all wish them to inherit a world with clean, productive, safe and secure seas – and the outcome of this Conference, by staving off an increasingly serious threat, will be essential to ensuring this is so".

It is hoped that these regulatory instruments will be implemented successfully and that by doing so the invasion rate will slow down resulting in an improved protection of European Seas and Black Sea in particular.

REFERENCES:

1. Ricciardi A., Patterns of invasion in the Laurentian Great Lakes in relation to changes in vector activity, *Diversity and Distributions*, vol. 12, iss.4, 2006, 425–433.
2. Molnar J.L, R.L. Gamboa, C. Revenga, M.D. Spalding, Assessing the global threat of invasive species to marine biodiversity, *Frontiers in Ecology and Environment* vol.6, iss.9, 2008, 485–492.
3. Tournadre J., Anthropogenic pressure on the open ocean: The growth of ship traffic revealed by altimeter data analysis. *Geophysical Research Letter*, vol.41, iss.22, 2014, 7924–7932.

4. Carlton J.T., The scale and ecological consequences of biological invasions in the world's oceans. *Invasive Species and Biodiversity Management*, 1999, 195-212.
5. Keller R.P., J.M. Drake, M.B. Drew, D.M. Lodge, Linking environmental conditions and ship movements to estimate invasive species transport across the global shipping network. *Diversity and Distributions*, vol. 17, iss.1, 2011, 93–102.
6. Gollasch S., Overview on introduced aquatic species in European navigational and adjacent waters. *Helgoland Marine Research* vol. 60, iss.2, 2006, 84-89.
7. Cohen A.N., J.T. Carlton, Biological study: non-indigenous aquatic species in a United States estuary: a case study of the biological invasions of the San Francisco Bay and Delta. *US Fisheries and Wildlife and National Sea Grant College Program Report PB96-166525*, Springfield, VA, USA, 1995, p.p. 273.
8. Kettunen, M., P. Genovesi, S. Gollasch, S. Pagad, U. Starfinger, P. ten Brink, C. Shine, Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU, 2009, Institute for European Environmental Policy, Brussels.
9. Mills, E.L., M.D. Scheuerell, J.T. Carlton, D.L. Strayer, Biological invasions in the Hudson River basin: an inventory and historical analysis. *New York State Museum Circular No. 57*, 1997, p. 51
10. Roques A, W. Rabitsch, J-Y. Rasplus, C. Lopez-Vamonde, W. Nentwig, M. Kenis, Alien terrestrial invertebrates of Europe. In: *DAISIE Handbook of alien species in Europe*, Springer, 2009, Dordrecht, 63–79.
11. Genovesi P, S. Bacher, M. Kobelt, M. Pascal, R. Scalera, Alien mammals of Europe, In: *DAISIE Handbook of alien species in Europe*. Springer, 2009, Dordrecht, 119–128.
12. Invasive Alien Species, Vectors Fact Sheet Series, http://www.marine-vectors.eu/factsheets/FS-12_general_alien.pdf.
13. Shine C, M. Kettunen P. ten Brink, P. Genovesi, S. Gollasch, Technical support to EU strategy on Invasive Alien Species (IAS), Institute for European Environmental Policy, 2009, p. 35.
14. Popescu I, Fisheries in the black sea, European parliament, Directorate General for Internal Policies, Policy Department B: structural and cohesion policies, Fisheries, 2010, p. 76.
15. Heileman S., Parr W., Volovik G., online. Black Sea: LME#62, http://www.lme.noaa.gov/index.php?option=com_content&view=article&id=108:lme62&catid=41:briefs&Itemid=72
16. Streftaris N, A. Zenetos, E. Papathanassiou, Globalisation in marine ecosystems: the story of non-indigenous marine species across European seas. *Oceanography and Marine Biology*, 2005, vol. 43, 419–453.
17. United States Coast Guard, Ballast water management for vessels entering the Great Lakes. Code of Federal Regulations 33-CFR Part 151.1510, 1993.
18. Locke, A., D.M. Reid, H.C. van Leeuwen, W.G.Sprules, J.T.Carlton, Ballast water exchange as a means of controlling dispersal of freshwater organisms by ships, *Canadian Journal of Fisheries and Aquatic Sciences*, 1993, vol.50, 2086–2093.
19. Niimi, A.J., D.M. Reid, Low salinity residual ballast discharge and exotic species introductions to the North American Great Lakes, *Marine Pollution Bulletin*, 2003, vol. 46, 1334–1340.
20. Niimi, A.J., Role of container vessels in the introduction of exotic species. *Marine Pollution Bulletin*, 2004, vol. 49, 778–782.
21. ICES, ICES code of practice on the introductions and transfers of marine organisms, 2003, p. 27.
22. REGULATION (EU) No 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species, *Official Journal of the European Union*, 04.11.2014, L 317/36.
23. IMO, International Convention for the Control and Management of Ships' Ballast Water and Sediments, London, 2004.
24. Lloyds Register, Understanding ballast water management, Guidance for ship owners and operators, Third edition, London, August 2016, p. 28.

ПРИЛАГАНЕТО НА МЕЖДУНАРОДНАТА КОНВЕНЦИЯ ЗА УПРАВЛЕНИЕ НА БАЛАСТНИТЕ ВОДИ – СЪПКА КЪМ ОПАЗВАНЕ НА ЧЕРНОМОРСКАТА ЕКО СИСТЕМА

Благовест Белев

Резюме: Морските екосистеми са подложени на нарастващ антропогенен натиск от дейности по море и по суша. Корабоплаването се е превърнало в мрежа, която обхваща света и въвежда много икономически и екологично вредни инвазивни видове, включително болести по хората като холера, например. Влиянието на корабният трафик, който е основната причина за промените в световния океан, и неговото временно нарастване, е все още в голяма степен недостатъчно проучено.

От 1906 година насам околната среда на Черно море е подложена на драстични промени. Счита се, че тези промени са резултат от сложно взаимодействие на различни фактори, най-важните от които са еутрофикация, прекомерен риболов и въвеждането на чужди видове.

Някои държави, както и Международната морска организация, са приели мерки в посока на установяване на изисквания за управление на баластните води на корабите, за да се постигне намаляване на броя на чужди видове, транспортирането и освобождаването им в чужди за тях води.

Ключови думи: Управление на баластните води, чужди морски видове, Черноморска екологична система

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