

Latissimus Dorsi Flap: A Winning Hand for Breast Reconstruction Salvage

Or Friedman MD^{1,3}, Ehud Fliss MD^{1,3}, Amir Inbal MD^{1,3}, Ehud Arad MD^{1,3}, Jacob Frand MD^{2,3} and Yoav Barnea MD^{1,3}

¹Department of Plastic and Reconstructive Surgery, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

²Department of General and Plastic Surgery, Wolfson Medical Center, Holon, Israel

³Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

ABSTRACT: **Background:** There are several methods for primary breast reconstruction following oncologic resection, including alloplastic and autologous-based reconstruction. Major complications that can lead to re-operation and reconstruction failure occur in up to 25% of the patients and necessitate salvage procedures.

Objectives: To present the authors' experience using a pedicled latissimus dorsi (LD) flap for the salvage of complicated and impending failed breast reconstruction.

Methods: A retrospective cohort study was conducted of all patients who underwent breast reconstruction salvage by means of an LD flap in our institution during a 5-year period. Demographic, oncologic, surgical, and postoperative data were collected and analyzed.

Results: Seventeen patients underwent breast reconstruction salvage with the LD flap. Fourteen patients had alloplastic reconstruction and three patients had autologous reconstruction. Postoperative complications included wound infection in three patients, minor wound dehiscence in two, and donor site seroma in two. One case of postoperative infection required re-operation with exchange of the implant with a tissue expander. All breast reconstructions were salvaged using the LD flap. Only one patient complained of functional limitations in using the arm of the harvested LD.

Conclusions: The LD flap is a valuable and reliable flap for alloplastic or autologous breast reconstruction salvage and has a high rate of salvage success despite the challenging surgical environment. This flap offers a good cosmetic reconstruction outcome with relatively low donor-site morbidity and high patient satisfaction.

IMAJ 2019; 21: 260–264

KEY WORDS: latissimus dorsi (LD) flap, breast reconstruction salvage

tissue expander and implant) and autologous reconstruction (body tissue). The past decade has witnessed an increase in the percent of patients undergoing reconstruction after mastectomy, with breast reconstructions largely being conducted in the immediate stage following the mastectomy [2]. The current gold standard for autologous reconstruction is the use of tissue from the lower abdominal wall as either a pedicle flap or a free flap [3]. Primary breast reconstruction using a latissimus dorsi (LD) flap has declined, mainly due to reported donor-site morbidity and the need to incorporate an implant in total breast reconstruction [3].

Complication and reconstructive failure rates in breast reconstruction vary significantly in the literature [2,3]. The many variables in patient demographics and co-morbidities, patient body habitus, tumor staging and anatomy, breast and lymph node surgery, and neo/adjuvant oncologic treatment make it difficult to determine the precise rate of surgical complications. Nevertheless, high-risk factors for complications have been established. These include morbid obesity, diabetes, smoking, chemotherapy, radiotherapy, locally advanced tumor, previous surgery, and alloplastic reconstruction [4-9]. Radiation therapy, given either before or after the reconstruction, has been shown to increase the complication and failure rates and to decrease patient satisfaction and overall outcome [9].

Major complications, such as skin necrosis, infection, wound dehiscence, capsular contracture, and fat necrosis, can lead to reconstruction failure and necessitate performing a procedure to salvage the reconstruction. Reconstruction failure results in tissue injury, chest wall distortion, soft tissue retraction, and scarring. Moreover, loss of the breast reconstruction has a significant emotional impact on the patient.

We present our experience managing both alloplastic and autologous breast reconstruction complications using the LD flap. Specifically, we assessed the long-term safety and outcome of an LD flap in these patients.

PATIENTS AND METHODS

This retrospective cohort study was approved by our institutional review board. We reviewed all breast reconstruction cases

For Editorial see page 285

Breast reconstruction after mastectomy has become common practice, with more than 100,000 procedures performed in 2016 in the United States alone [1]. The methods for breast reconstruction include alloplastic reconstruction (breast

performed at our medical center and at a private clinic over a 5-year period from 2012 to 2017. All the reconstructions were conducted after lumpectomy or mastectomy for breast cancer. We retrieved all cases of breast reconstruction complications and included those patients who underwent a secondary operation for salvaging the reconstruction using the LD flap. All of the enrolled patients were followed at our plastic surgery outpatient clinic. Those who underwent breast revision surgery that did not include an LD flap or implant removal were excluded.

Data on the patients were extracted from a computerized database and included demographic details, co-morbidities, oncologic status, primary reconstruction details, follow-up visit summaries, and operative details regarding the salvage reconstruction. Data on the salvage procedure included surgical details, postoperative hospitalization, immediate complications, late complications, and outcome.

RESULTS

A total of 220 immediate breast reconstruction surgeries were performed during the study period, 29 (13%) of which had major complications leading to re-operation. A total of 17 patients underwent breast reconstruction salvage with the LD flap due to major complications and impending failure during the study period [Table 1]. All the study patients had undergone surgical resection due to breast cancer and none had a prophylactic mastectomy. Their mean age at the time of surgery was 51 years (range 35–65). Six patients (35%) reported current pre-operative smoking. Six patients (35%) received neoadjuvant chemotherapy treatment prior to primary reconstruction, and four patients (23%) received chemotherapy after the primary reconstruction. All but two patients (88%) received radiotherapy prior to the salvage procedure. Both non-radiated patients had complications after immediate alloplastic breast reconstruction. One had wound dehiscence and the other implant infection.

The primary reconstructive modality included an alloplastic reconstruction in 14 patients (82%) and an autologous reconstruction in 3 (18%). Eight patients in the alloplastic group

(47%) had direct-to-implant reconstruction, and six patients (35%) were reconstructed by means of a tissue expander. All alloplastic reconstructions were conducted immediately at the time of the mastectomy. All patients in the autologous group underwent delayed reconstruction by means of a deep inferior epigastric perforator (DIEP) flap. Seven patients (41%) underwent an additional operation prior to the LD salvage procedure. Six of these patients changed treatment course, which led to insertion of a tissue expander due to infection or wound dehiscence/implant exposure, and the seventh underwent a planned exchange of a tissue expander with an implant [Table 2].

The reason for the LD salvage procedure in the alloplastic reconstruction group included implant infection in five patients (36%), wound dehiscence/implant exposure in five (36%), and severe capsular contracture in four (28%) [Figure 1]. The reason in the autologous reconstruction group was partial flap loss due to microvascular complication in three patients [Figure 2]. The LD was harvested as a myocutaneous flap in 13 patients (76%), as a muscle-sparing flap in 2 (12%), and as a perforator flap (thoraco-dorsal artery perforator [TDAP] flap) in 2 (12%). The flap was used solely as an autologous flap with no implant in three patients (18%), all in the autologous reconstruction group.

The mean postoperative hospitalization was 7 days (range 3–15 days). Postoperative complications included wound infection in three patients (18%) and mild wound dehiscence in two (12%). One case of postoperative infection required re-operation with exchange of the implant to a tissue expander. All breast reconstructions were salvaged using the LD flap. Donor site complications included a seroma that was treated conservatively in two patients. One patient complained of physical limitation when using the arm of the harvested LD.

DISCUSSION

Breast cancer remains the most commonly diagnosed non-cutaneous malignancy in women, with roughly 1 in 8 women developing breast cancer during their lifetime [10]. Patients requiring mastectomy for their disease are candidates for breast reconstruction. This option has gained popularity in the past decade, primarily due to the establishment of multidisciplinary breast teams and greater availability of plastic surgeons, in addi-

Table 1. Major reconstructive complications and treatment

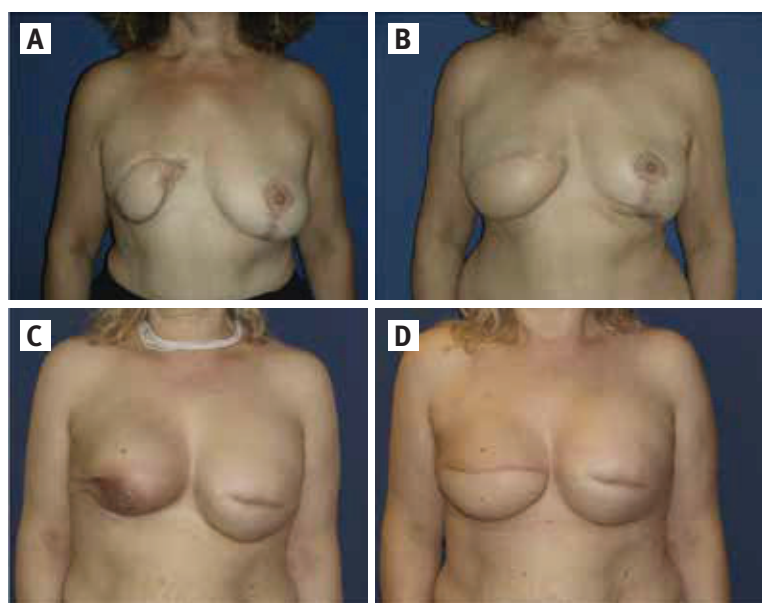
	Number	Major complications, n (%)	Number of secondary procedures
Total mastectomy reconstructions	220	29 (13%)	
Treated by debridement and replacement of implant		1 (3.4%)	1
Treated by exchange to expander		5 (17.3%)	2
Treated by explantation and delayed reconstruction		6 (20.1%)	3
Salvage by latissimus dorsi		17 (58.6%)	1
Acute salvage		3 (17%)	
Chronic salvage		14 (83%)	

Table 2. Primary vs. salvage latissimus dorsi breast reconstruction major complications

	Number (%)	Major complications, n (%)	Reconstructive failure, n (%)
Total latissimus dorsi cases	58 (100%)	6 (10%)	1 (1.7%)
Salvage	17 (29%)	1 (5.8%)	0 (0%)
Primary	41 (71%)	5 (12.5%)	1 (2.4%)
Literature review results		14%	2.80%

Figure 1. A 59-year-old otherwise healthy patient underwent right mastectomy due to breast cancer, followed by chemotherapy and radiation therapy to the right chest. Three years later right breast reconstruction with a deep inferior epigastric perforator (DIEP) flap and left mastopexy was performed. She developed partial flap loss due to venous congestion. **[A]** One year later she underwent right reconstruction salvage with thoraco-dorsal artery perforator (TDAP) flap and left secondary mastopexy **[B]**. The previous DIEP flap skin island was de-epithelialized and buried under the TDAP skin island.

A 44-year-old otherwise healthy patient who underwent bilateral mastectomy due to right breast cancer and immediate reconstruction with implants and acellular dermal matrix (ADM). She received neoadjuvant chemotherapy and radiation therapy to the right chest after surgery. She developed right breast infection with impending implant exposure **[C]**. She underwent removal of the implant and debridement of the lower pole skin and reconstruction with latissimus dorsi (LD) myocutaneous flap and implant **[D]**.



tion to patient education and awareness [10-11]. There is an increase in the percent of patients who undergo reconstruction after mastectomy and an increase in the percent of immediate breast reconstructions performed at the time of the mastectomy procedure [11]. The rising demand for breast reconstruction has resulted in the development of two main procedures, broadly classified as alloplastic (implant-based) and autologous (tissue-based) reconstruction.

Immediate breast reconstruction performed in continuation with the mastectomy has many advantages, such as better cosmetic outcome, fewer surgeries, and enhanced patient psychosocial well-being [8-11]. However, the disadvantages include higher complication rates, namely infection, skin necrosis, wound dehiscence, and reconstruction failure [8-11]. The rate of complications increases even higher in cases of radiation therapy administered before or after the reconstructive procedure [12].

Reconstruction failure results in tissue injury, chest wall distortion, soft tissue retraction, and scarring. Moreover, the loss of

a reconstructed breast has a significant emotional impact on the patient. These sequelae call for enhanced salvage procedures in our surgical arsenal, which can be used in cases of complications leading to reconstruction failure and serve as rescue options for achieving a successful reconstruction. In this study, we presented our experience with breast salvage reconstruction using the LD flap in both alloplastic and autologous reconstructions.

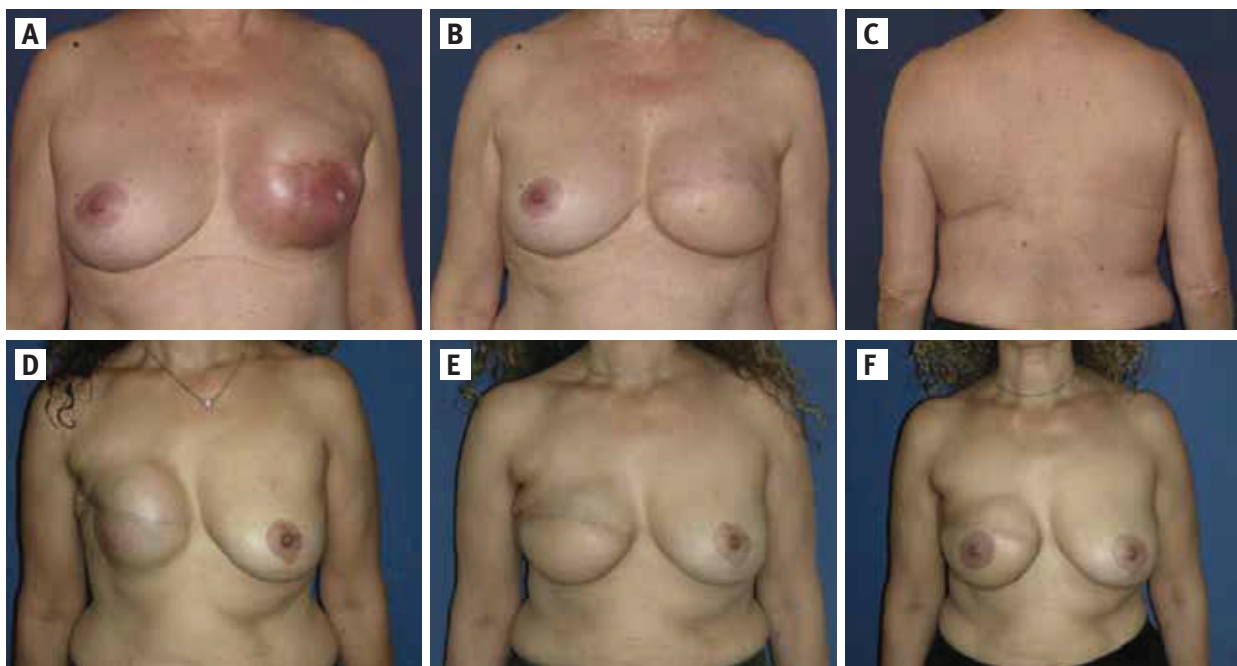
The LD flap is well-recognized for its efficacy in breast reconstruction. Many articles have been published since the procedure was first introduced in 1912 [13-15]. It is a reliable flap that is simple to harvest. It has a rich pedicled blood supply and there is no need for microsurgical anastomosis or recipient vessel dissection. The procedure offers a transfer of bulky tissue and muscle, fat, or both, with a relatively large skin island. The LD is highly versatile in supporting a variety of flap orientations and a wide arc of rotation, reaching up to the anterior midline area. This technique allows further flexibility in flap inseting and shaping, in both the immediate and delayed setting [14,15]. All of those characteristics of the LD flap make it a good option for salvage procedures conducted in previously operated and/or radiated breast fields [6,12].

In the current study, the reasons for reconstruction salvage included implant infection (5 cases), wound dehiscence/implant exposure (5 cases), severe capsular contracture (4 cases), and partial flap loss (3 autologous reconstruction cases). All of those cases were either reconstruction failures or impending reconstruction failures, which would have resulted in failure in the absence of an additional salvage procedure. The LD salvage procedure can be further divided into acute salvage, which is performed during the same hospitalization period of the initial reconstruction, and delayed salvage, which is performed at a later date. The acute type salvage included three patients (18%) who had flap necrosis with impending implant exposure. They received local wound treatment until clear wound demarcation and underwent the LD salvage procedure during the same hospitalization period. Fourteen patients (82%) underwent a delayed LD salvage procedure that was performed 1 to 6 months after the initial reconstruction. Patients with severe capsular contracture after receiving post-mastectomy radiotherapy were re-operated at least 6 months after completion of the radiotherapy.

Complications after LD salvage procedures included infection in three patients (18%), one of whom required open irrigation and exchange of the implant to a tissue expander. Four patients had minor complications, including wound dehiscence and donor-site seroma, and all healed with conservative treatment. All flaps were viable, and there were no cases of vascular compromise. The final outcome was that all the salvage procedures were successful, including the case of postoperative infection that required exchange of the implant. This finding is noteworthy, considering the challenging conditions encountered during a salvage procedure, such as active infection, radiation, and scarring. Some patients were hospitalized for 2

Figure 2. A 56-year-old otherwise healthy patient who underwent left mastectomy due to breast cancer and immediate reconstruction with an implant and acellular dermal matrix (ADM) and right mastopexy. She received chemotherapy followed by radiation therapy to the left chest. She developed left breast infection with implant exposure **[A]**. She underwent removal of the implant and debridement of the lower pole skin and reconstruction with latissimus dorsi (LD) myocutaneous flap and implant **[B]**. The donor site healed unevenly **[C]**.

A 59-year-old patient with treated hypothyroidism who underwent right mastectomy due to breast cancer and immediate reconstruction with an implant and ADM and left mastopexy. She received chemotherapy followed by radiation therapy to the right chest. She developed severe capsular contracture of the right breast **[D]**. She underwent removal of the implant, subtotal capsulectomy, and reconstruction with muscle-sparing LD flap and implant **[E]**. Six months later she underwent right nipple-areolar complex reconstruction **[F]**.



weeks just to receive intravenous antibiotics after the salvage procedure in implant infection cases.

Furthermore, all the patients in our current series had good aesthetic outcome, including at the donor site, with no noticeable sequelae from the LD harvest. Only one patient complained of limitation in the donor arm's range of motion. She had undergone a modified radical mastectomy followed by radiation to the chest wall and axilla, at which point she started complaining of limitation of motion in her arm. Her initial reconstruction was with a DIEP flap with partial fat necrosis, and her reconstruction salvage was with a LD flap.

The use of LD flaps for breast reconstruction has declined over the past decade, largely due to superior primary reconstruction alternatives, both alloplastic and autologous [2,3]. Those options, together with the reported donor-site morbidity of the LD flap, have led to a reduction of LD flap usage for breast reconstruction [3,16]. Recent technology and enhanced surgical techniques, however, have ameliorated the pitfalls of LD breast reconstruction. Surgical techniques, such as the muscle-sparing LD approach or the use of a TDAP flap, have lowered the rate of donor-site morbidity [3,17].

Moreover, the use of autologous fat grafting for the donor and recipient sites as well as the use of donor-site sealants have improved the surgical outcome and reduced donor-site morbidity [8-10,17].

A literature search for LD breast reconstruction showed a 14% major complication rate and 2.8% flap failure rate, similar to our institutional complication rates of 12.5% and 2.4%, respectively. In our series, the major complication rate for LD salvage procedure was 5.8% and the failure rate was 0% [Table 2]. All flaps were viable, and there was no case of vascular compromise. Only two patients had donor-site seroma, which was treated conservatively. The relatively low complication rate in the LD salvage cases is surprising due to the high-risk environment in which the salvage procedure took place. This result could be attributed to the relative small number of cases or the bias of over treatment in salvage cases compared to primary cases. When dealing with breast reconstruction, major complications, and impending failure, the LD procedure is an important tool for the surgeon to salvage the reconstruction.

During the study period, we encountered 29 cases of major complications among which 17 patients were treated with LD

salvage procedure. The remaining 12 patients were treated with implant removal [Table 1]. This result caused a latent period with no reconstruction and further surgeries for delayed reconstruction. The decision making in these high risk cases must include the medical, surgical, and oncological status of the patient, as well as the mental status and the consequences of reconstruction failure.

CONCLUSIONS

The LD muscle serves as a valuable and reliable flap for alloplastic or autologous breast salvage reconstructions, and has a high rate of salvage success, in spite of the challenging surgical environment. It offers a good cosmetic reconstruction outcome, with relatively low donor-site morbidity and high patient satisfaction.

Conflict of interest statement

Dr. Barnea is a speaker for Johnson Medical

Acknowledgements

The authors thank Esther Eshkol for her editorial assistance

Correspondence

Dr. Y. Barnea

Dept. of Plastic and Reconstructive Surgery, Tel Aviv Sourasky Medical Center, Tel Aviv 6423906, Israel

Phone: (972-3) 697-3320

Fax: (972-3) 697-3890

email: ybarnea@gmail.com

References

- American Society of Plastic Surgeons. Plastic Surgery Statistics Report 2016 Reconstructive Breast Procedures. [Available from <https://www.plasticsurgery.org/documents/News/Statistics/2016/plastic-surgery-statistics-full-report-2016.pdf>]. [Accessed 4 August 2017].
- Frey JD, Choi M, Salibian AA, Karp NS. Comparison of outcomes with tissue expander, immediate implant, and autologous breast reconstruction in greater than 1000 nipple-sparing mastectomies. *Plast Reconstr Surg* 2017; 139: 1300-10.
- Hanson SE, Smith BD, Liu J, Robb GL, Kronowitz SJ, Garvey PB. Fewer revisions in abdominal-based free flaps than latissimus dorsi breast reconstruction after radiation. *Plast Reconstr Surg Glob Open* 2016; 4: e866.
- Hvilsom GB, Friis S, Frederiksen K, et al. The clinical course of immediate breast implant reconstruction after breast cancer. *Acta Oncol* 2011; 50: 1045-52.
- Tsoi B, Ziolkowski NI, Thoma A, Campbell K, O'Reilly D, Goeree R. Safety of tissue expander/implant versus autologous abdominal tissue breast reconstruction in postmastectomy breast cancer patients. *Plast Reconstr Surg* 2014; 133: 234-49.
- Spear SL, Boehmler JH, Taylor NS, Prada C. The role of the latissimus dorsi flap in reconstruction of the irradiated breast. *Plast Reconstr Surg* 2007; 119: 1-9.
- Chen TA, Momeni A, Lee GK. Clinical outcomes in breast cancer expander-implant reconstructive patients with radiation therapy. *J Plast Reconstr Aesthetic Surg* 2016; 69: 14-22.
- Spear SL, Boehmler JH, Bogue DP, Mafi AA. Options in reconstructing the irradiated breast. *Plast Reconstr Surg* 2008; 122: 379-88.
- Shah C, Kundu N, Arthur D, Vicini F. Radiation therapy following postmastectomy reconstruction: a systematic review. *Ann Surg Oncol* 2013; 20: 1313-22.
- Da Chao AH, Khansa I, Farrar WB, Miller MJ. Processes of care in breast reconstruction and the long-term impact of a comprehensive breast center. *Ann Surg Oncol* 2015; 22 (Suppl 3): S1256-62.
- Barnea Y, Friedman O, Arad E, et al. An oncoplastic breast augmentation technique for immediate partial breast reconstruction following breast conservation. *Plast Reconstr Surg* 2017; 139: 348e-357e.
- Spear SL, Masden D, Rao SS, Nahabedian MY. Long-term outcomes of failed prosthetic breast reconstruction. *Ann Plast Surg* 2013; 71: 286-91.
- D'Este S. La technique de l'amputation de la mamelle pour carcinoma mammaire (The technique of amputation of the nipple for breast carcinoma). *Rev Chir* 1912; 45: 194. [French].
- Hammond DC. Latissimus dorsi flap breast reconstruction. *Clin Plast Surg* 2007; 34: 75-82.
- Hammond DC. Latissimus dorsi flap breast reconstruction. *Plast Reconstr Surg* 2009; 124: 1055-63.
- Blackburn NE, McVeigh JG, Mc Caughan E, Wilson IM. The musculoskeletal consequences of breast reconstruction using the latissimus dorsi muscle for women following mastectomy for breast cancer: a critical review. *Eur J Cancer Care (Engl)* 2018; 27 (2): e12664.
- Angrigiani C, Rancati A, Escudero E, Artero G. Extended thoracodorsal artery perforator flap for breast reconstruction. *Gland Surg* 2015; 4: 519-27.
- Bennett KG, Qi J, Kim HM, Hamill JB, Pusic AL, Wilkins EG. Comparison of 2-year complication rates among common techniques for postmastectomy breast reconstruction. *JAMA Surg* 2018; 153: 901-8.

Capsule

Amphibian fungal panzootic causes catastrophic and ongoing loss of biodiversity

Rapid spread of disease is a hazard in our interconnected world. The chytrid fungus *Batrachochytrium dendrobatidis* was identified in amphibian populations about 20 years ago and has caused death and species extinction at a global scale. **Scheele** and colleagues found that the fungus has caused declines in amphibian populations everywhere, except at its origin in Asia. A majority of species and populations are still experiencing decline, but there is evidence of limited recovery in some species. The analysis also suggests some conditions that predict resilience. Anthropogenic trade and development have broken down dispersal barriers, facilitating the spread of diseases that threaten Earth's biodiversity. The authors presented a global, quantitative assessment of the amphibian chytridiomycosis panzootic, one of the most

impactful examples of disease spread, and demonstrated its role in the decline of at least 501 amphibian species over the past 50 years, including 90 presumed extinctions. The effects of chytridiomycosis have been greatest in large-bodied, range-restricted anurans in wet climates in the Americas and Australia. Declines peaked in the 1980s, and only 12% of declined species show signs of recovery, whereas 39% are experiencing ongoing decline. There is risk of further chytridiomycosis outbreaks in new areas. The chytridiomycosis panzootic represents the greatest recorded loss of biodiversity attributable to a disease.

Science 2019; 363: 1459

Eitan Israeli